UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ANALIZNA KEMIJA I
Course Title:	ANALYTICAL CHEMISTRY I

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE111

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

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

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Osnovni pojmi in parametri analiznega procesa: faze analize, izbira metode, priprava vzorca, umerjanje, občutljivost, selektivnost, meja zaznave, napake. Ravnotežja v analizni kemiji: pomen in pregled ravnotežij v homogenih in heterogenih sistemih. Sistematična obravnava ravnotežij: masna bilanca, električna nevtralnost, porazdelitveni diagrami. Hetereogena ravnotežja in vplivi na topnost (pH, ligandi, elektroliti, topilo), kislinsko bazna ravnotežja, ravnotežja pri koordinacijskih spojinah. Kemijske analizne tehnike – precizijska analiza Gravimetrija: principi, vplivi na kristalizacijo, značilne aplikacije in viri napak (koprecipitacija, koloidi).	Basic terms and parameters of analytical processes: aims of analytical chemistry, general steps in chemical analysis, sample preparation, calibration, sensitivity, limit of detection, errors in chemical analysis. Aqueous solution chemistry: equilibria in homogeneous systems: systematic treatment of chemical equilibria, mass balance, charge balance, fractional composition diagrams. Equilibria in heterogeneous systems and influences on solubility (pH, ligands, electrolytes, solvent). Monoprotic and polyprotic acid-base equilibria, metal-ligand equilibria. Chemical analytical techniques – precision analysis.

Titrimetrija: principi, napake, indikacija končne točke. Pregled titracij: obarjalne in nevtralizacijske titracije v vodnih in nevodnih medijih, titracije eno in večprotičnih kislin/baz ter amfiprotičnih snovi, pufrska kapaciteta. Kompleksometrične titracije (teorija, računalniške simulacije, viri napak), pomembnejše aplikacije. Separacijski postopki v analizni kemiji: obarjalne separacije, kompleksiranje.	Gravimetry: principles, influences on crystallisation, applications, sources of errors (coprecipitation, colloids). Titrimetry: principles, sources of errors, end-point indication. Precipitation titrations. Neutralisation titrations in aqueous and non-aqueous systems, mono- and polyprotic acid/base titrations, titration of amphiprotic species, buffer capacity. Complexometric titrations: principles, sources of errors, computer simulations, applications. Separation processes in analytical chemistry: precipitation separations, complex formation.

Temeljna literatura in viri / Readings:

Temeljna:

- B. Pihlar, H. Prosen, Uvod v analizno kemijo, Založba UL FKKT, Ljubljana 2021, 147 str.

Dodatna:

- D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, 9. izdaja, Brooks Cole, London 2013, poglavja 1-4, 9-17 (325 str.).
- D.C. Harris, Quantitative Chemical Analysis, 8. izdaja, W.H. Freeman and Company 2010, poglavja 1-13 (279 str.).

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Slušatelji osvojijo temeljne principe in značilnosti kemijske analize. Kompetence: Spoznajo in se naučijo uporabljati pomen kemijskih ravnotežij in reakcij za analizo ter spoznajo in se naučijo uporabljati različne kemijske analizne metode in osnovne separacijske postopke.	Objectives: Understanding of principles of basic analytical methods and approaches. Competences: ability to solve problems connected with chemical equilibria in homogeneous and heterogeneous systems, ability to recognize sources of error in analysis and to interpret and critically evaluate analytical results.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent spozna osnovne pojme značilne za kemijsko analizo, obvlada pristope k obravnavi kemijskih ravnotežij v homogenih in heterogenih sistemih in spozna njihov pomen za kemijsko analizo in posamezne tehnike. Spozna osnovne kvantitativne analizne tehnike, obvlada njihove teoretske značilnosti in spozna značilne aplikacije.	<u>Knowledge and Comprehension</u> Student understands basic principles of chemical analysis, is able to find appropriate approaches for solving problems in chemical equilibrium in homogenous and heterogenous systems and is able to connect these problems with chemical analysis and analytical techniques. Student acquires knowledge about basic quantitative analytical techniques, about their theoretical characteristics and typical applications.

Uporaba Študent pridobi temeljna znanja iz kvantitativne analize in osnove, potrebne za razumevanje snovi pri višjih kurzih (Analizna kemija II, Instrumentalna analiza) in drugih predmetih.	Application Student acquires basic knowledge of quantitative analysis, which are needed in other courses in 2nd and 3rd year of study (e.g. Analytical Chemistry II and Instrumental Analysis).
Refleksija Nauči se kritičnega pristopa do informacij in obravnave eksperimentalnih rezultatov.	Analysis Critical view towards the information and treatment of experimental data.
Prenosljive spretnosti Osvoji pristope k reševanju analiznih problemov, zna uporabiti teoretične principe v praksi, obvlada obdelovanje podatkov in njihovo predstavitev.	Skill-transference Ability Approaches for solving analytical problems, use of theoretical principles in practice, experimental data handling and their presentation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- Predavanja z demonstracijskimi eksperimenti, - seminarji usmerjeni v poglabljanje in razumevanje teorije in reševanje praktičnih primerov, - laboratorijski seminar (LS) namenjen pridobivanju osnovnih eksperimentalnih prijemov in pristopov v kemijski analizi.	Lectures with demonstration experiments. Seminars aimed at deeper understanding of theory and solving practical problems. Laboratory seminar aimed at gaining basic experimental skills and approaches in chemical analysis.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit z oceno 6 ali več (uspešno – po Statutu UL).		Written and oral exam.

Reference nosilca / Lecturer's References:

- KLOBČAR, Slavko, **PROSEN, Helena**. Isolation of oxidative degradation products of atorvastatin with supercritical fluid chromatography. Biomedical chromatography, ISSN 1099-0801, 2015, vol. 29, iss. 12, str. 1901-1906, ilustr. http://onlinelibrary.wiley.com/doi/10.1002/bmc.3513/abstract, doi: 10.1002/bmc.3513. [COBISS.SI-ID 1536354499]
- ĆIRIĆ, Andrija, **PROSEN, Helena**, JELIKIĆ STANKOV, Milena, ĐURĐEVIĆ, Predrag. Evaluation of matrix effect on determination of some bioflavonoids in food samples by LC-MS/MS method. Talanta, ISSN 0039-9140. [Print ed.], 2012, vol. 99, no. 1, str. 780-790, doi: 10.1016/j.talanta.2012.07.025. [COBISS.SI-ID 36369157]
- **PROSEN, Helena**, KOKALJ, Meta, JANEŠ, Damjan, KREFT, Samo. Comparison of isolation methods for the determination of buckwheat volatile compounds. Food chemistry, ISSN 0308-8146. [Print ed.], 2010, vol. 121, no. 1, str. 298-306, doi: 10.1016/j.foodchem.2009.12.014. [COBISS.SI-ID 33728005]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ANALIZNA KEMIJA II
Course Title:	ANALYTICAL CHEMISTRY II

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	/	2.	3.
USP Chemistry, 1st Cycle	/	2nd	3rd

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE112

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
40	35	/	/	/	75	5

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

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

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

Vsebina:	Content (Syllabus outline):
Statistika in vrednotenje analiznih rezultatov: naključne in sistematične napake, statistični parametri in obdelava podatkov, širjenje negotovosti, zagotavljanje kakovosti v analizni praksi. **Instrumentalne analizne tehnike – razdelitev in značilnosti** Osnovne elektrokemijske zakonitosti: napetost člena in odvisnost od koncentracije, redoks titracije. Potenciometrija: principi, indikatorske in referenčne elektrode, steklena elektroda in ISE, viri napak, potenciometrična indikacija pri različnih vrstah titracij. Voltametrične tehnike: tokovno-napetostna zveza, polarizacija. Elektrogravimetrija in	**Statistics and evaluation of analytical results:** random, systematic error, statistical parameters and data processing, propagation of uncertainty, quality assurance in analysis. **Instrumental analytical techniques - types and properties** Basic electrochemical concepts: cell potential, its relation to concentration, redox titration. Potentiometry: principles, indicator and reference electrodes, glass electrode, ISE, source of errors, potentiometric indication in titrimetry. Voltammetry: current-voltage relationship, polarization. Electrogravimetry and coulometry: principles, source of errors, typical applications. **Basic spectroscopic techniques and types of**

kulometrija: principi, viri napak, značilne aplikacije. **Osnovne spektroskopske tehnike in pregled metod:** Interakcija elektromagnetnega valovanja s snovjo, principi tehnik in uporabnost v analizni kemiji. Molekulska absorpcijska spektrometrija in fluorescenca: osnovne zakonitosti in značilnosti tehnik (merilni obseg, selektivnost, interference) in aplikacije. Plamenska fotometrija in emisijska spektrometrija: osnovni principi, aparatura, karakteristike metod (merilni obseg, selektivnost, interference), značilne aplikacije v analitiki anorganskih sestavin. **Osnove separacij v analizni kemiji:** Principi in teorija separacijskih tehnik, kromatografski parametri. Tankoplastna kromatografija, osnove kolonske analizne kromatografije. Osnove elektroforeze. Ekstrakcija tekoče-tekoče, porazdelitveni koeficient. Osnovni pojmi in principi odvzema in priprave vzorcev.	**methods:** Interaction of electromagnetic radiation with matter, principles of techniques, applicability in analytical chemistry. Molecular absorption spectrometry and fluorescence: basic concepts and properties (measurement range, selectivity, interferences), applications. Flame photometry and emission spectrometry: basic principles, instrument, method characteristics (measurement range, selectivity, interferences), typical applications in inorganic analysis. **Basic separation techniques in analytical chemistry:** Principles and theory of separation techniques, chromatographic parameters. Thin-layer chromatography, basics of column analytical chromatography. Basics of electrophoresis. Liquid-liquid extraction and partition coefficient. Basic concepts and principles of sampling and sample preparation.

Temeljna literatura in viri / Readings:

Temeljna:

B. Pihlar, H. Prosen, Osnove analizne kemije, Založba UL KKT, Ljubljana 2019, 230 str.

Dodatna:

1. D. A. Skoog, D. M. West, F. J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, 8th Ed., Thomson Brooks/Cole, London, 2004, poglavja 5-9, 18-28;
2. D. C. Harris, Quantitative Chemical Analysis, 5th ed., Freeman, New York, 1999.
3. Analytical Chemistry A Modern Approach to Analytical Science, Ed. by R. J.- Mermet, M. Otto, M. Valcarcel, Founding Editors: R. Kellner, H.M. Widmer, Wiley - VCH, Weinheim, 2004.

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Slušatelji pridobijo v okviru predmeta znanja, potrebna za izvedbo nekaterih osnovnih instrumentalnih analiznih tehnik. Kompetence: Usposobijo se za eksperimentalno delo in spoznajo pristope za izvedbo kompleksnih analiz, načine vrednotenja merskih rezultatov ter reševanja analiznih nalog in problemov v praksi.	Objectives: Students gain the knowledge necessary to perform certain basic instrumental analytical techniques. Competences: Gaining ability for experimental work, learning approaches to perform complex analyses, evaluation of results and practical solving of analytical problems and tasks.
Predvideni študijski rezultati:	**Intended Learning Outcomes:**

Znanje in razumevanje	Knowledge and Comprehension
Študent osvoji osnovne principe statistične obravnave rezultatov, kot so natančnost in pravilnost, meja zaznave in občutljivost, merilna negotovost. Zna izbrati analizno metodo in rezultate kritično ovrednotiti. Obvlada posamezne instrumentalne analizne tehnike, pozna njihove pomembnejše karakteristike in omejitve ter značilne aplikacije.	Knowledge and comprehension Student learns the basic principles of statistical evaluation of results, i.e. precision, accuracy, limit of detection, sensitivity, measurement uncertainty. Is able to select an analytical method and critically evaluate the results. Masters certain instrumental analytical techniques, knows their principal characteristics, limitations and typical applications.
Uporaba Študent se usposobi za samostojno delo v analiznem laboratoriju in pridobi temeljna znanja, potrebna za razumevanje snovi pri višjih kurzih (Instrumenalna analiza) in raziskovalnem delu.	Application Student qualifies for autonomous work in the analytical lab; gains fundamental knowledge to understand the subject matter of succeeding courses (Instrumental Analysis) and research work.
Refleksija Nauči se kritičnega pristopa do informacij in obravnave eksperimentalnih rezultatov.	Analysis Learns to critically evaluate the information and experimental results.
Prenosljive spretnosti Osvoji pristope k reševanju analiznih problemov, zna uporabiti teoretične principe v praksi, izvesti analizo po standardnih postopkih in navedbah v literaturi, obvlada obdelovanje podatkov in njihovo predstavitev.	Skill-transference Ability Masters the approaches to solve analytical problems; can use theoretical principles in the praxis; can perform analysis by standard procedures and methods from the literature; masters data processing and their presentation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
a) Predavanja z demonstracijskimi eksperimenti, b) seminarji usmerjeni v poglabljanje in razumevanje teorije in reševanje praktičnih primerov	a) Lectures with practical demonstrations b) seminars to enhance the understanding of theoretical principles and to solve practical examples.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit	**50 %**	Written exam
Ustni izpit	**50 %**	Oral exam

Reference nosilca / Lecturer's references:

- A. Ćirić, **H. Prosen**, M. Jelikić Stankov, P. Đurđević. Evaluation of matrix effect in determination of some bioflavonoids in food samples by LC-MS/MS method. *Talanta* 2012, 99, 780-790.
- **H. Prosen**, M. Kokalj, D. Janeš, S. Kreft. Comparison of isolation methods for the determination of buckwheat volatile compounds. *Food Chem.* 2010, 121, 298-306.
- I. Kralj Cigić, **H. Prosen**. An overview of conventional and emerging analytical methods for the

determination of mycotoxins. *Int. J. Mol. Sci.* 2009, 10, 62-115.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ANORGANSKA KEMIJA
Course Title:	INORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemijsko inženirstvo, 1. stopnja, UŠP Biokemija, 1. stopnja, UŠP Kemija, 1. stopnja	**/**	**1.**	**2.**
USP Chemical Engineering, 1st Cycle, USP Biochemistry, 1st Cycle, USP Chemistry, 1st Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE108

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

Nosilec predmeta / Lecturer: prof. dr. Anton Meden / Dr. Anton Meden, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
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.	**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.

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.

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.

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 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 CO_2. 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:

- Boris Čeh, Anorganska kemija, Založba UL FKKT, Ljubljana 2019, 351 str.

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

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> 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).	<u>Knowledge and Comprehension</u> 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).
<u>Uporaba</u> Pridobljeno znanje in razumevanje so potrebna osnovna znanja, ki jih študent uporablja za razlago eksperimentalno določenih ali drugače pridobljenih podatkov,	<u>Application</u> 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

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	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.
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.	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.
Prenosljive spretnosti Študent zna poiskati podatke iz strokovne literature, podatke iz virov medmrežja pa zna kritično oceniti. Zna uporabljati strokovni jezik (pisno in ustno).	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 (v %) / Weight (in %)	**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/c003065a. [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]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ANORGANSKA KEMIJA II
Course Title:	INORGANIC CHEMISTRY II

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI6

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

Nosilec predmeta / Lecturer: prof. dr. Franc Perdih / dr. Franc Perdih, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Vsebina predavanj: **Splošne lastnosti d- in p-elementov:** Lega v periodnem sistemu in primerjalni pregled kovinskih elementov. Elektronske konfiguracije in oksidacijska števila. Spektroskopske metode in magnetne meritve kot orodja za določanje nekaterih lastnosti spojin d- elementov. **Koordinacijske spojine:** Tipi ligandov. Teoretske osnove koordinacijske vezi. Strukture kompleksov in izomerija. Stabilnost kompleksov in izmenjava ligandov. Organokovinske spojine. Uporaba koordinacijskih spojin. **Vsebina seminarjev:** Študentje bodo pripravili in predstavili seminarje o zanimivih lastnostih in aplikacijah,	*Lectures:* **General properties of d- and p-block elements:** The review of metals. Electronic configurations and oxidation numbers. Spectroscopic methods and magnetic measurements as tools to determine properties of d-block elements. **Coordination compounds:** Types of ligands. Coordination bond theories. Structure of complexes and isomerism. Stability of complexes and exchange of ligands. Organometallic compounds. Applications of metal complexes. **Seminars***:* Preparation and presentation of selected properties and applications of d-block metals. **Practical course:**

ki so povezane s prehodnimi kovinami. **Vsebina laboratorijskih vaj:** Študenti bodo pri vajah izvajali različne tipe sintez, ki se uporabljajo v anorganski kemiji in spoznavali lastnosti izoliranih snovi (spojine s prehodnimi elementi in elementi p-bloka, primeri izomerije, karakterizacija anorganskih spojin, projektno zasnovana vaja).	Different types of syntheses typical for inorganic chemistry will be performed and the properties of isolated products will be studied (compounds containing transition elements and elements of p-block, examples of isomers, characterization of inorganic compounds; project-based exercise).

Temeljna literatura in viri / Readings:

- C. E. Housecroft, A. G. Sharpe, Inorganic Chemistry, Second Edition, Pearson Education Limited, Harlow, England, 2005 (949 strani). (Izbrana poglavja: 19: 535-554; 20: 555-591; 21: 591-644; 22: 645-699; skupaj 164 strani). Nekaj izvodov knjige je na voljo v knjižnici FKKT (UL).

Priporočena dodatna literatura:

- G. A. Lawrance, Introduction to Coordination Chemistry, Wiley, Chichester, United Kingdom, 2010 (290 strani). (Izbrana poglavja: 5: 125-172; 6: 173-208; 7: 209-228; skupaj 104 strani).
- F. Lazarini, J. Brenčič, Splošna in anorganska kemija, FKKT UL, Ljubljana, 2004 (557 strani). (Izbrana poglavja: 11: 240-258; 21-31: 428-513; skupaj 103 strani).

Na spodnji spletni strani študentje lahko poiščejo razne podatke za pomoč pri študiju: http://wps.pearsoned.co.uk/ema_uk_he_housecroft_inorgchem_2/25/6533/1672517.cw/index.html.
Večino podatkov za pripravo seminarjev bodo študentje pridobili iz znanstvenih revij in učbenikov, ki so bodisi dostopne na fakulteti ali preko spleta (baze podatkov kot SciFinder Scolar, Web of Science).

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je predvsem pridobiti znanje o d- elementih (3. -12. skupina periodnega sistema) in o spojinah, ki jih ti elementi tvorijo. Študent spozna lastnosti koordinacijskih spojin in tudi njihovo možno uporabo. Študentje si pri predmetu pridobijo naslednje **specifične kompetence**: - utrjujejo logično mišljenje, spoznavajo strategijo reševanja problemov in pridobijo zmožnost predstavitve znanstvenih problemov pred strokovno javnostjo, - pri laboratorijskih vajah pridobijo večjo samostojnost pri praktičnem sintetskem delu. Hkrati so sposobni z uporabo različnih metod preiskati izolirane produkte, - nadgradijo tudi svoje znanje o interpretaciji podatkov ter povezovanju teorije in eksperimentalnega dela.	***Learning outcomes:*** The main aim is to extend the knowledge of d-block elements (3.-12. group of periodic table) and their compounds. Another goal is to extend student`s acquaintance with coordination compounds and their possible applications. ***Competences:*** Ability to logically solve the problems, to interpret the data and to present the results to professional public. To be able to perform practical synthetic work more independently and to be able to characterize the isolated products by different physico-chemical methods. To be able to connect theoretical principles with practical work.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Predmet s poglobljenim pregledom kemije d-elementov, predstavlja nadaljevanje anorganskih predmetov iz prvega in drugega letnika. Študent je sposoben demonstrirati znanje in razumevanje bistvenih podatkov, konceptov in teorij, ki so povezane s pojmi vsebovanimi v opisu vsebine.	Knowledge and Comprehension The advanced inorganic chemistry course of d-block elements represents an extension of inorganic subject from the first and second academic years. The student is able to present the knowledge and understanding of the essential data, concepts and theories related to the content of the course described above.
Uporaba Študent spozna, kako osnovno znanje o kovinskih ionih in ligandih uporabiti za načrtovanje sintez spojin in tudi predvidevanje njihovih lastnosti. Sposoben naj bi bil uporabljati svoje znanje interdisciplinarno in na praktičnih primerih. Laboratorijsko delo je nadgradnja osnovnih praktikumov in študenta uvaja v večjo samostojnost in izurjenost v sinteznem laboratoriju, kot tudi v praktično uporabo metod za karakterizacijo.	Application Student learns how basic knowledge of metal ions and ligands can be used to plan and perform the synthesis of coordination compounds and predicting their properties. The emphasis is on the application of his/her knowledge interdisciplinary and problem-based examples. Laboratory work is at the advance level and upgrades the competence and skills in the synthesis laboratory as well as in the practical application of methods for characterization.
Refleksija Študent bo na seminarjih interpretiral izbrano temo ter jo pred kolegi analiziral, na osnovi lastnega razumevanja vsebine člankov iz strokovnih revij oziroma poglavij iz knjig. Vsebina vaj je tesno povezana s temami seminarjev in predavanj, zato se študent nauči kritičnega razmišljanja o skladnosti med teoretičnimi načeli in prakso.	Analysis Student will present an overview of the chosen topic during the seminars and will give an in-depth analysis of the topic on the basis of his own understanding of the content of articles in scientific journals or book chapters. Lab courses are closely related to the topics of seminars and lectures and enable students to critically evaluate the consistency between theoretical principles and practice.
Prenosljive spretnosti Poznavanje vsebin in način dela omogočata boljše razumevanje zakonitosti pri drugih predmetih študija in povečata širino znanja. Samostojno delo (iskanje literature, zbiranje in interpretacija podatkov, predstavitev) je prenosljivo na mnoge druge predmete študija. Naučene spretnosti (teoretične, računske, eksperimentalne) so kot podlaga koristne pri anorganskih predmetih magistrske stopnje (Koordinacijska kemija, Organokovinska in supramolekularna kemija, Anorganska kemija), prav tako pa služijo tudi pri osebnem profesionalnem razvoju.	Skill-transference Ability The obtained skills at this course enable better understanding of the principles in other courses during the academic study and broaden the scientific knowledge. Individual work (literature search, collection and interpretation of data, presentation) is transferable to many other subjects of study. Learned skills (theoretical, computational, experimental) are useful as a basis for inorganic courses at the Master`s degree level (Coordination Chemistry, Organometallic and Supramolecular Chemistry, Inorganic Chemistry), as well as, serve in their personal professional development.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
-predavanja, -seminarji, -praktične vaje v laboratoriju.	lectures, -seminars, -practical exercises in the lab.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pogoj za opravljanje izpita je pozitivna ocena iz vaj: praktično opravljene vse vaje in pozitivno ocenjena poročila vaj. Ocena izpita: ocena seminarja (20 %), ocena iz vaj (20 %), ustni izpit (60 %).	**20 %** **20 %** **60 %**	Entering condition for exam is a positive assessment of the lab work: successfully finished laboratory course and positive mark of all lab reports. Exam mark: assessment of the seminar (20%), assessment of the lab work (20%), oral exam (60%).

Reference nosilca / Lecturer's references:

1. D. Sanna, J. Palomba, G. Lubinu, P. Buglyó, S. Nagy, **F. Perdih**, E. Garribba: Role of ligands in the uptake and reduction of V(V) complexes in red blood cells. J. Med. Chem. **2019**, 62, 654–664.
2. T. Koleša Dobravc, K. Maejima, Y. Yoshikawa, A. Meden, H. Yasui, **F. Perdih**: Bis(picolinato) complexes of vanadium and zinc as potential antidiabetic agents: synthesis, structural elucidation and in vitro insulin-mimetic activity study. New J. Chem. **2018**, 42, 3619–3632.
3. T. Koleša Dobravc, E. Lodyga-Chruscinska, M. Symonowicz, D. Sanna, A. Meden, **F. Perdih**, E. Garribba: Synthesis and characterization of VIVO complexes of picolinate and pyrazine derivatives. Behavior in the solid state and aqueous solution and biotransformation in the presence of blood plasma proteins. Inorg. Chem. **2014**, 53, 7960–7976.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ANORGANSKA SINTEZA
Course Title:	INORGANIC SYNTHESIS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**4.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI1

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

Nosilec predmeta / Lecturer: prof. dr. Franc Perdih / Dr. Franc Perdih, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Vsebina seminarjev in vaj: Študenti bodo pri predmetu sintetizirali anorganske snovi z različnimi sinteznimi tehnikami in dobljene snovi preiskali. Spoznali bodo metode sinteze: hidrotermalna sinteza, sol-gel tehnika, enostavne načine dela v inertni atmosferi, reakcije v trdnem stanju, sinteza koordinacijske spojine. Metode karakterizacije pa so predznanju študentov prirejena uporaba rentgenske praškovne analize, termične analize in infrardeče spektroskopije. Študenti bodo sintetizirali bazični bakrov(II) sulfat, zemeljskoalkalijske oksalate hidrate, polimerno snov silikon, fluorooksovanadate(IV), titanov dioksid po sol-gel postopku, itrij-barij-bakrov superprevodnik in do dve snovi, ki se	Syntheses and characterizations of inorganic compounds. Different methods of syntheses are applied: hydrothermal synthesis, sol-gel technique, syntheses of unstable compounds, simple experiments in an inert atmosphere, solid state reactions, syntheses of coordination compounds. Basic copper(II) sulphate, alkaline earth oxalates hydrates, a polymeric silicone, fluoridooxidovanadate(IV), titanium dioxide (sol-gel method), Y-Ba-Cu-superconductor and some new complexes which are subject of current research at the department of Inorganic chemistry are prepared and characterized. Infrared spectroscopy, UV-vis spectroscopy, thermal analysis and X-ray powder diffraction analysis are used to

uporabljata pri tekočem raziskovalnem delu nosilca predmeta ali njegovih sodelavcev. Pri seminarju bodo študenti dobili potrebno teoretsko osnovo in navodila za sintezo.	characterize prepared compounds. The characterization methods are adapted to the knowledge level of these students. Theoretical background is explained in seminars.

Temeljna literatura in viri / Readings:

S. Petriček, F. Perdih in A. Demšar, Vaje iz anorganske kemije, FKKT UL, Ljubljana, 2010, 25-30, 47-68, 75-115.

Articles published in scientific journals.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je nadgraditi znanje študentov iz predmetov Splošna kemija in Anorganska kemija. Kompetence: Praktične laboratorijske veščine in izkušnje s področja sinteze in karakterizacije anorganskih snovi.	Expanding a basic knowledge of syntheses and characterization of inorganic compounds obtained in courses of General and Inorganic Chemistry. Practical skills in comprehensive inorganic syntheses and characterization of inorganic compounds.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Predmet predstavlja dopolnitev predmeta Splošna in anorganska kemija s praktičnim delom in izkušnjami.	Knowledge and Comprehension The subject adds practical skills and experience to the previous courses of General and Inorganic Chemistry.
Uporaba Študent spozna, da je osnovno znanje prvega letnika dobra podlaga za zanimivo laboratorijsko delo in daje študentu vznemirljivo možnost iz reaktantov sintetizirati (»ustvariti«) novo snov.	Application Students find out that basic knowledge obtained during the first year study could be applied in challenging syntheses of new compounds.
Refleksija Kemija je eksperimentalna veda, zato se je študentom lažje motivirati pri osvajanju teoretskega znanja, če spoznajo, da je to znanje potrebno pri eksperimentiranju.	Analysis Applications of a theoretical background in practicals enhance motivation of the students for a comprehensive theoretical studies.
Prenosljive spretnosti Laboratorijske veščine, izkušnje in prijemi pri načrtovanje sintez so pomembni pri drugih kemijskih predmetih in pri osebnemu strokovnemu razvoju.	Skill-transference Ability Practical skills and experience in planning of syntheses are useful also in other courses and important for a professional development.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predmet se izvaja v obliki seminarjev in samostojnih laboratorijskih vaj. Na seminarju se tematiko vsake vaje umesti v širši kontekst anorganske kemije.	A broad background of each experiment performed by students in practicals is explained in seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Poročila vaj (pozitivno 6-10; negativno 5)	20%	Laboratory reports (positive 6-10; negative 5)
Študent ustno predstavi seminar na temo sodobne anorganske sinteze kolegom;	20%	Oral presentation of a selected topic in advanced inorganic syntheses in a class:
Pisni izpit (pozitivno 6-10; negativno 5);	60%	Written exam (positive 6-10; negative 5)
Delni oceni za vaje in izpit morata biti pozitivni.		Laboratory reports and written exam must be positive.

Reference nosilca / Lecturer's references:

1. D. Sanna, J. Palomba, G. Lubinu, P. Buglyó, S. Nagy, **F. Perdih**, E. Garribba: Role of ligands in the uptake and reduction of V(V) complexes in red blood cells. J. Med. Chem. 2019, 62, 654–664.

2. T. Koleša Dobravc, K. Maejima, Y. Yoshikawa, A. Meden, H. Yasui, **F. Perdih**: Bis(picolinato) complexes of vanadium and zinc as potential antidiabetic agents: synthesis, structural elucidation and in vitro insulin-mimetic activity study. New J. Chem. 2018, 42, 3619–3632.

3. T. Koleša Dobravc, E. Lodyga-Chruscinska, M. Symonowicz, D. Sanna, A. Meden, **F. Perdih**, E. Garribba: Synthesis and characterization of VIVO complexes of picolinate and pyrazine derivatives. Behavior in the solid state and aqueous solution and biotransformation in the presence of blood plasma proteins. Inorg. Chem. 2014, 53, 7960–7976.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOLOŠKA KEMIJA
Course Title:	BIOLOGICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**5.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE120

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

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

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Metode za separacijo bioloških makromolekul, metode za preučevanje bioloških makromolekul, koencimi in kofaktorji – pregled in vloga pri encimski katalizi, prenos molekul po živih organizmih, koncept sklopljenih reakcij, pretvarjanje energije v živih organizmih: dihalna veriga, oksidativna fosforilacija in fotosinteza, pregled metabolizma ogljikovih hidratov, lipidov, aminokislin, nukleotidov in drugih molekul, ki vsebujejo dušik, koncept kontrole metaboličnega pretoka, uravnavanje metabolizma in drugih procesov na ravni aktivnosti encimov, uravnavanje metabolizma in drugih procesov na ravni izražanja genov.	Methods for isolation and study of biological macromolecules, cofactors and their role in enzyme catalysis, transport of molecules and ions in living organisms, the concept of coupled reactions, energy transformation in living organisms: electron transport and oxidative phosphorylation, the overview of metabolism of carbohydrates, lipids, amino acids, nucleotides and other nitrogen containing compounds, regulation of metabolism and other processes on the level of the enzymatic activity, regulation of metabolism and other processes on the level of gene expression.

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:**
Cilj: Študent bo spoznal uporabnost kemije pri študiju bioloških sistemov. **Kompetence**: Študent bo znal uporabiti svoje znanje kemije za razlago biokemijskih procesov in bo sposoben nadgrajevati svoje znanje na tem področju.	Objectives: Students will learn the applicability of chemistry in studying biological systems. Competences: Student will know how to use the knowledge of chemistry for the interpretation of biochemical processes and will be capable of upgrading their knowledge in the field.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent bo dobil pregled čez procese, ki potekajo v živih organizmih in bo znal uporabiti svoje znanje kemije pri njihovi razlagi. Razumel bo pomen strukture bioloških molekul za njihovo delovanje, imel dober pregled čez metabolizem in načine uravnavanja procesov v živih organizmih.	Knowledge and Comprehension Student will gain an overview of the processes in living organisms and will be able to use his knowledge of chemistry in explaining them. He will understand the function of biological macromolecules based on their structure and will have basic overview of metabolism and its regulation in living organisms.
Uporaba Študent bo znal uporabljati osnovne metode za proučevanje delovanja encimov in njihovih inhibitorjev, osnovne biokemijske tehnike kot so elektroforeza, metode za izolacijo proteinov in nukleinskih kislin in nekatere računalniške programe bioinformatike. Znal bo pridobivati novo znanje, ločevati dejstva od mnenj ter povzemati in integrirati informacije in ideje na področju biokemije.	Application Use of basic methods to study proteins, enzymes and their inhibitors, such as electrophoresis, methods for protein and DNA isolation, basic bioinformatics skills. Student will be able to gain new knowledge, discern facts from opinions and to integrate and abstract new information in the field of biochemistry.
Refleksija Študent se bo zavedal omejitev posameznih metod in pomanjkljivosti teorij, zavedal se bo nevarnosti pri delu z biološkim materialom in dilem na področju etike v biomedicinskih raziskavah.	Analysis Student will be aware of the limitations of different methods and theories, will have understanding of the biohazards and will be aware of the ethical concerns in biomedical research.
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 člankov na področju biokemije.	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 scientific literature.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, laboratorijske vaje, seminarji, projektno delo.	Lectures, laboratory practicals, seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- seminarska naloga - kolokvij iz vaj - pisni izpit Opravljene vaje so pogoj za pristop k izpitu.		- seminar - test -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 AvrL567-A and -D Reveal Details of the Structural Basis for Flax Disease Resistance Specificity. ***Plant Cell***, 2007, 19, 2898-2912. *authors contributed equally

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	DIPLOMSKO DELO
Course Title:	DIPLOMA WORK

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: D1KE

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

Nosilec predmeta / Lecturer: /

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

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

Vsebina:	Content (Syllabus outline):
Diplomsko delo se opravlja na področju kemije. Vsebina in naslov se določita 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.	Diploma's thesis is performed in one of the areas ofchemistry. The contents and the title are agreed upon with the mentor. Mentor is a teacher at UL, FKKT or employed at assistant position with habilitation of Assistant Professor, Associate Profesor or Full Professor. Mentor is also a teacher who lectures at 1st or 2nd cycle of studies at UL, FKKT. Mentor should teach at the programme where student is involved.

Temeljna literatura in viri / Readings:

Knjige in članki, povezani z vsebino diplomskega dela.

Books and journal articles related to the research topic.

Cilji in kompetence:	**Objectives and Competences:**
Cilj: Dokončno oblikovanje pričakovanega lika diplomanta. **Kompetence**: Študent ob izdelavi diplomske naloge izpopolni sposobnosti iskanja in zaznavanja kemijskih problemov ter iskanja rešitev za te probleme. Pri delu bo uporabil večino kompetenc navedenih v programu študija.	Final formation of the competences of a diploma's degree candidate. Through carrying out research for the diplom's thesis student should be able to demonstrate the skills for autonomous identification of a problem related to chemival engineering and finding solutions, thus proving that specific competences from the programme have been acquired.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Pri izdelavi diplomskega dela bo slušatelj pridobil: - sposobnosti formuliranja problema, - sposobnosti samostojnega iskanja ustrezne literature, - sposobnosti načrtovanja eksperimentalnih in teoretskih poti do rešitve problema, - sposobnosti kritičnega vrednotenja pridobljenih podatkov in utemeljevanja ustreznosti rešitev, - sposobnosti predstavitve rezultatov svojega dela.	Knowledge and Comprehension Through carrying out research for the diploma's thesis student will develop skills for formulating the problem and he will be able for independent literature review. He will develop ability to solve actual problems and he will be able to confirm his decisions and solutions. He will develop skills for presentation of his work.
Uporaba Znanje in pridobljene veščine bo diplomant lahko uporabil pri opravljanju poklica.	Application Student with diploma will be able to use acquired knowledge in his professional carrier as chemist.
Refleksija Povezovanje vseh pridobljenih teoretičnih znanj z reševanjem problemov na področju kemije ter kritični pogled na uporabnost teh znanj.	Analysis Connection of all acquired theoretical knowledge to solve problems in the chemistry. Critical distance to acquired knowledge.
Prenosljive spretnosti Pri delu bo diplomant pridobil znanja o metodah reševanja problemov ter o načinu predstavitve znanj in rezultatov v pisni in govorni obliki.	Skill-transference Ability Research for the diplom's thesis will help the student to gain knowledge on problem solving methodologies, how to present acquired knowledge as well as results in writen in oral form.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Samostojno študijsko in raziskovalno delo pod individualnim mentorskim vodstvom.	Individual work with mentor and independent self-study and research work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Komisija v sestavi: predsednik, mentor, član oceni diplomsko delo in zagovor diplomskega dela. Ocene so v skladu s Statutom UL (1-5 negativno, 6-10 pozitivno)		The committee members evaluate the work and the defense. (1-5 negative, 6-10 positive)

Reference nosilca / Lecturer's references:

/

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	FIZIKA
Course Title:	PHYSICS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemijsko inženirstvo, 1. stopnja, UŠP Biokemija, 1. stopnja, UŠP Kemija, 1. stopnja	**/**	**1.**	**1. in 2.**
USP Chemical Engineering, 1st Cycle, USP Biochemistry, 1st Cycle, USP Chemistry, 1st Cycle	**/**	**1.**	**1st and 2nd**

Vrsta predmeta / Course Type: Obvezni/Mandatory

Univerzitetna koda predmeta / University Course Code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
90	/	**60 SV**	/	/	**150**	**10**

Nosilec predmeta / Lecturer:
prof. dr. Svjetlana Fajfer / Dr. Svjetlana Fajfer, Full Professor
prof. dr. Janez Bonča / Dr. Janez Bonča, Full Professor
prof. dr. Igor Muševič / Dr. Igor Muševič, Full Professor

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

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

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

Prerequisites:

The course has to be assigned to the student.

Vsebina:

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

Content (Syllabus outline):

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.

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 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	**Fluid mechanics:** hydrostatics, hydrostatic pressure; buoyancy; hydrodynamics; description of fluid flow; Bernoulli's equation. **Oscillation and wave motions: a**mplitude, frequency and oscillation intervals; harmonic oscillation; oscillation of molecules, forced oscillation; oscillation of coupled oscillators; oscillation spectrum; 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: s**tatic 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 osnovnih fizikalnih pojmov in fizikalnih količin, spoznajo osnovne zakone narave ter se ob reševanju problemov navadijo osnov analitičnega mišljenja.	Knowledge and Comprehension During the physics course students obtain the 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.
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,	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
Refleksija Pridobljeno znanje fizikalnih osnov bo študentu omogočilo kritično ovrednotiti rezultate laboratorijskih meritev in poglobljeno razumevanje predpisanih postopkov pri izvajanju meritev.	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.

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.	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 (v %) / Weight (in %)	**Assessment:**
Pisni izpit iz računskih vaj. Končna ocean je sestavljena iz		Written exam problem solving. Final score:
-izpita iz teorije	**50 %**	theory: 50%,
-izpita iz vaj	**50 %**	problem solving: 50%.
Ocene 6-10 pozitivno.		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).

PREDLAGANE SPREMEMBE	
Predmet:	FIZIKALNA KEMIJA
Course Title:	PHYSICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**3. in 4.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**3rd and 4th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
100	**50**	**/**	**/**	**/**	**150**	**10**

Nosilec predmeta / Lecturer: prof. dr. Andrej Jamnik / Dr. Andrej Jamnik, Full Professor

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

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

Vsebina:	**Content (Syllabus outline):**
Osnovni pojmi in enačbe stanja Sistem, stanje, funkcije stanja in funkcije poti. Plinski zakoni, idealni plin. Realni plini, van der Waalsova enačba, virialna enačba, kritični pojavi. **Kinetična teorija plinov** Tlak plina. Maxwellova porazdelitvena funkcija hitrosti molekul in translacijskih kinetičnih energij. Kinetična energija in temperatura. Pogostost trkov med molekulami in trkov molekul s steno. **Prvi zakon termodinamike** Energija, toplota, delo. Prvi termodinamski zakon. Obrnljivi in neobrnljivi procesi. Entalpija. Toplotna kapaciteta. Termokemija. **Entropija in drugi zakon termodinamike**	**Basic concepts and equations of state** System, state, state functions and path functions. Gas laws, ideal gas. Real gases, van der Waals equation, virial equation, critical phenomena. **Kinetic theory of gases** Pressure of a gas. Maxwell distribution of molecular speeds and translational kinetic energies. Kinetic energy and temperature. Frequency of intermolecular collisions and collisions of molecules with the walls and surfaces. **First law of thermodynamics** Energy, heat, work. First law of thermodynamics. Reversible and irreversible processes. Enthalpy. Heat capacity.

Spontane in nespontane spremembe. Termodinamska definicija entropije. Sprememba entropije v izoliranem in v zaprtem sistemu, Clausiusova neenenakost. Molekularna interpretacija entropije. Računanje entropijskih sprememb pri različnih spremembah stanja.

Entropija in tretji zakon termodinamike

Praktične absolutne entropije. Standardne entropije. Sprememba entropije pri kemijskih reakcijah.

Prosta energija in prosta entalpija

Termodinamski potenciali, splošni pogoji za ravnotežje in za spontane procese. Sprememba proste entalpije pri kemijskih reakcijah. Odvisnost proste entalpije od temperature in tlaka. Maxwellove enačbe.

Fazna ravnotežja

Faza in komponenta. Kemijski potencial. Prostostne stopnje, fazno pravilo. Clapeyronova in Clausius-Clapeyronova enačba. Fazni diagrami čistih snovi.

Raztopine

1) *Raztopine dveh hlapnih tekočin*

Parcialne molske količine. Idealne in neidealne raztopine. Raoultov zakon in Henryjev zakon. Fazni diagrami parni tlak-sestava in vrelni diagrami. Kemijski potencial, aktivnost in aktivnostni koeficient posameznih komponent raztopine. Standardna stanja na osnovi Raoultovega in Henryjevega zakona. Termodinamika mešanja. Ravnotežje trdno-tekoče: enostavni eutektični fazni diagrami.

2) *Raztopine trdnega topljenca v tekočem topilu* Standardno stanje, kemijski potencial, aktivnost in aktivnostni koeficient topila in topljenca. Kemijski potencial močnih elektrolitov, aktivnost ionov in srednja aktivnost elektrolita, aktivnostni koeficient in srednji aktivnostni koeficient. Koligativne lastnosti.

Fazni diagrami trokomponentnih sistemov.

Kemijsko ravnotežje

Izpeljava splošnega izraza za kemijsko ravnotežje. Konstanta ravnotežja. Homogena in heterogena ravnotežja. Odvisnost konstant ravnotežja od temperature in tlaka, Le

Thermochemistry.

Entropy and the second law of thermodynamics

Spontaneous and nonspontaneous changes. Thermodynamic definition of entropy. Entropy changes in isolated and in closed systems, Clausius inequality. Molecular interpretation of entropy. Calculation of entropy changes for various changes of state.

Entropy and the third law of thermodynamics

Practical absolute entropies. Standard entropies. Entropy changes in chemical reactions.

Free energy and free enthalpy

Thermodynamic potentials, general conditions for equilibrium and for spontaneous changes. Free enthalpy changes in chemical reactions. Temperature and pressure dependence of the free enthalpy. Maxwell relations.

Phase equilibria

Phase and component. Chemical potential. Degrees of freedom. Phase rule. Clapeyron and Clausius - Clapeyron equation. Phase diagrams of pure substances.

Solutions

1) *Liquid – liquid solutions*

Partial molar quantities. Ideal and non-ideal solutions. Raoult's law and Henry's law. Vapour pressure - composition and temperature - composition phase diagrams. Chemical potential, activity, and activity coefficient of individual components of the solution. Raoult's law and Henry's law standard states. Thermodynamics of mixing. Solid-liquid equilibrium: simple eutectic phase diagrams.

2) *Solid – liquid solutions*

Standard state, chemical potential, activity and activity coefficient of the solvent and the solute. Chemical potential of strong electrolytes, activity of ions and mean activity of electrolyte, activity coefficient and mean activity coefficient. Colligative properties.

Phase diagrams of ternary systems.

Chemical equilibrium

Derivation of a general expression for the chemical equilibrium. Equilibrium constant. Homogeneous and heterogeneous equilibria.

Chatelierov princip. **Raztopine elektrolitov** Močni in šibki elektroliti. Specifična in molska prevodnost. Električni tok skozi raztopino, transportno število, gibljivost ionov. Koligativne lastnosti raztopin elektrolitov. Debye - Hückelova teorija, Debye - Hückelov limitni zakon. **Elektrokemijski členi** Elektroliza. Galvanski členi: delovanje, spontana reakcija v členu. Reverzibilna napetost člena. Termodinamika galvanskega člena. Nernstova enačba. Standardni redukcijski potenciali. Različni tipi členov. Uporaba galvanskih členov. **Kemijska kinetika** Hitrost reakcije. Elementarne reakcije: red reakcije, hitrostni zakon in konstanta reakcijske hitrosti. Empirični hitrostni zakoni. Zaporedne, vzporedne in obojesmerne reakcije. Vpliv temperature na hitrost reakcije, Arrheniusova enačba. Mehanizem reakcije. Verižne reakcije in eksplozije. Trkovna teorija in teorija prehodnega stanja. Homogena in heterogena kataliza. Encimska kataliza. **Površinska kemija** Površinska napetost in kapilarni pojavi, Laplaceova enačba in Kelvinova enačba. Površinsko aktivne snovi, micelizacija. Kemisorpcija in fizisorpcija. Termodinamika adsorpcije. Langmuirjeva in Freundlichova adsorpcijska izoterma.	Temperature and pressure dependence of equilibrium constants, Le Chatelier principle. **Solutions of electrolytes** Strong and weak electrolytes. Specific and molar conductivity. Electric current through the solution, transport number, mobility of ions. Colligative properties of electrolyte solutions. Debye - Hückel theory, Debye - Hückel limiting law. **Electrochemical cells** Electrolysis. Galvanic cells: operation, spontaneous reaction in the cell. EMF of galvanic cell. Thermodynamics of galvanic cells. Nernst equation. Standard reduction potentials. Various types of cells. Application of galvanic cells. **Chemical kinetics** Rate of reaction. Elementary reactions: order of reaction, rate law and rate constant. Empirical rate equations. Consecutive and parallel reactions, reactions approaching equilibrium. Effect of temperature on reaction rate, Arrhenius equation. Reaction mechanism. Chain reactions and explosions. Collision and transition state theories. Homogeneous and heterogeneous catalysis. Enzyme catalysis. **Surface chemistry** Surface tension and capillarity, Laplace and Kelvin equations. Surfactants, micellization. Chemisorption and physisorption. Thermodynamics of adsorption. Langmuir and Freundlich adsorption isotherms.

Temeljna literatura in viri / Readings:

- A. Jamnik, Fizikalna kemija (1. izdaja), založba FKKT (2013), ISBN: 978-961-6756-39-6 (1. zvezek) in ISBN: 978-961-6756-40-2 (2. zvezek).

Dopolnilna literatura

- P. Atkins and J. de Paula, Atkins' Physical Chemistry (9. izdaja), Oxford University Press (2010), ISBN: 978-0-19-954337-3.
- R. J. Silbey, R. A. Alberty, and M. G. Bawendi, Physical Chemistry (4. Izdaja), John Wiley, New York (2005), ISBN: 978-0-471-21504-2.

Cilji in kompetence:	**Objectives and Competences:**
Pri fizikalni kemiji, ki sodi med osnovne kemijske predmete, študenti spoznajo povezavo med fizikalnimi in kemijskimi pojavi	Physical chemistry is one of the basic chemistry courses. The objective of this subject is to study connections between physical and chemical

ter med fizikalnimi in kemijskimi lastnostmi snovi. Njegov cilj je študentu posredovati temeljno znanje fizikalne kemije, ki kasneje zadošča na običajnem delovnem mestu kemika, omogoča pa tudi samostojno nadaljnje izobraževanje. Pri tem se ne omejuje samo na podajanje posameznih enačb in zakonov, ampak daje poseben poudarek interpretaciji metod in razvoju modelov, ki do njih vodijo. Pri študiju fizikalne kemije študent nedvomno razvija sposobnost kritičnega razmišljanja in logičnega sklepanja.	phenomena and between physical and chemical properties of the matter. Its main goal is to convey the principal laws of physical chemistry. A great deal of attention is paid to training the students in the application of theoretical expressions to problems that are commonly encountered by chemists at ordinary working places. It provides the understanding of a group of principles and methods helpful in solving many different types of problems encountered in natural sciences. In the study of physical chemistry students undoubtedly develop the ability of critical thinking and logical reasoning.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Poznavanje osnovnih fizikalno-kemijskih količin kot so notranja energija, delo, toplota, entalpija, prosta energija in entropija. Poznavanje osnovnih zakonov termodinamike. Razumevanje pojmov obrnljivosti (reverzibilnosti) in neobrnljivosti (ireverzibilnosti) procesov. Uporaba tabeliranih fizikalno-kemijskih podatkov (standardne tvorbene entalpije, standardne entropije, toplote faznih prehodov, toplotne kapacitete) pri določanju termodinamike kemijskih reakcij pri različnih pogojih. Poznavanje kriterijev za spontanost poteka kemijskih reakcij ter za kemijsko ravnotežje. Razumevanje razlike med termodinamiko (spontanostjo poteka) ter kinetiko (hitrostjo poteka) kemijske reakcije.	Knowledge and Comprehension Knowledge of the basic physicochemical properties like internal energy, work, heat, enthalpy, free energy, and entropy. Knowledge of the basic thermodynamic laws. Understanding the concept of reversibility and irreversibility of processes. Use of tabulated thermodynamic data (standard enthalpies of formation, standard entropies, heats of phase changes, heat capacities) for the thermodynamic description of chemical reactions at different conditions. Knowledge of various criteria for chemical equilibrium and for the direction of spontaneous chemical or physical change at different conditions. Understanding basic differences between thermodynamics (spontaneity) and kinetics (rate) of chemical reactions.
Uporaba Zaradi svojega temeljnega pomena je pridobljeno znanje fizikalne kemije zelo široko uporabno. Vse moderne analizne metode so osnovane na fizikalno kemijskih principih. Poleg tega je, tako iz energetskega kot iz kinetičnega vidika, znanje fizikalne kemije nujno potrebno pri vodenju kemijskih in biokemijskih procesov. Podobno velja, da je globlje razumevanje procesov, ki nastopajo v bio-sistemih, brez ustreznega znanja fizikalne kemije nemogoče. Iz vsega tega sledi, da je znanje fizikalne kemije nepogrešljivo pri razvojnem, proizvodnem ter kontrolnem delu	Application Because of the fundamental importance of physical chemistry the acquired knowledge offers very broad applicability. All modern analytical methods are based on physicochemical principles. Moreover, the knowledge of physical chemistry is necessary for a controlled conduct of chemical and biochemical processes, both from energetic as well as from kinetic point of view. Deeper understanding of various biochemical processes is also impossible without adequate knowledge of physical chemistry. Hence it follows that the knowledge of physical chemistry is

vrste porabnikov kot so npr. kemijska, farmacevtska, živilsko-predelovalna in tekstilna industrija ter mnogi razvojni in kontrolni laboratoriji v drugih dejavnostih.	indispensable for the development, production and control work type of users, such as chemical, pharmaceutical, food-processing, textile industries as well as for many development and control laboratories.
Refleksija Pridobitev občutka za fizikalno-matematični način razmišljanja ter spoznanja o splošnih fizikalno-matematičnih metodah za reševanje različnih praktičnih problemov iz naravoslovja. Globlje razumevanje pomena abstraktnih fizikalno-kemijskih pojmov in količin.	Analysis Students gain a sense for physico-mathematical thinking and a knowledge of the general physico-mathematical methods for solving various practical problems in natural sciences. In addition, they gain a deeper understanding of the significance of abstract physico-chemical principles and properties.
Prenosljive spretnosti Uporaba splošnih naravoslovnih zakonitosti pri študiju naravoslovnih vsebin, ki so zajete pri drugih predmetih. Pri študiju fizikalne kemije se pri večini študentov razvije kritičen in analitičen način razmišljanja, kar jim zelo koristi pri identifikaciji in reševanju različnih teoretičnih in praktičnih problemov, s katerimi se soočijo na svoji poklicni poti. Kritično ovrednotenje rezultatov katerihkoli (ne le fizikalno-kemijskih) meritev. Uporaba domače in tuje znanstvene literature.	Skill-transference Ability Use of the general physico-chemical principles in the study of various topics covered by other subjects. During the study of physical chemistry the students develop critical and analytical way of thinking, which helps them in identifying and solving very different practical and theoretical problems being encountered at any working place during their professional career. They also acquire the ability to critically evaluate whichever (not only physico-chemical) experimental data. Use of scientific literature.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- Predavanja - Seminarji	- Lectures - Seminars

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit, ki ga lahko nadomestijo štirje pozitivno ocenjeni kolokviji. Ocenjevanje: 6-10 (pozitivno); 1-5 (negativno).		Written examination, which can be accomplished by achieving positive grades of four written tests. Marks: 6-10 (positive); 1-5 (negative).

Reference nosilca / Lecturer's references:

- A. Jamnik, Effective interaction between large colloidal particles immersed in a bidisperse suspension of short-ranged attractive colloids, J. Chem. Phys. 131, 2009, art. no. 164111-1-1644111-8.
- A. Jamnik, Simulating asymmetric colloidal mixture with adhesive hard sphere model, J. Chem. Phys. 128, 2008, art. no. 234504 (10 str.).
- A. Lajovic, M. Tomšič, G. Fritz-Popovski, L. Vlček, A. Jamnik, Exploring the structural properties of simple aldehydes: A Monte Carlo and small-angle x-ray scattering study, J. Phys. Chem. B 113, 2009, 9429-9435.
- M. Tomšič, A. Jamnik, G. Fritz, O. Glatter, L. Vlček, Structural properties of pure simple

alcohols from ethanol, propanol, butanol, pentanol, to hexanol: Comparing Monte Carlo simulations with experimental SAXS data, J. Phys. Chem. B 111, 2007, 1738-1751.
- S. Zhou, A. Jamnik, E. Wolfe, S. Buldyrev, Local structure and thermodynamics of a core-softened potential fluid: Theory and simulation, ChemPhysChem. 8, 2007, 138-147.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	FIZIKALNA KEMIJA TEKOČIN IN RAZTOPIN
Course Title:	PHYSICAL CHEMISTRY OF LIQUIDS AND SOLUTIONS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI10

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

Nosilec predmeta / Lecturer: prof. dr. Marija Bešter Rogač / Dr. Marija Bešter Rogač, Full Professor
doc. dr. Bojan Šarac / Dr. Bojan Šarac, Assistant Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Tekočine: klasifikacija tekočin, medmolekulske sile, urejenost v tekočinah, enačbe stanja. Osnovne fizikalne in kemijske lastnosti tekočin: molska masa in molski volumen, vrelišča in tališča. Termodinamske lastnosti čistih tekočin: termodinamika faznih ravnotežij, enostavni fazni diagrami. Tekoči kristali: urejenost in molekularna struktura v tekočih kristalih. Polarne tekočine: dielektrične lastnosti, voda, strukturne lastnosti tekoče vode, nevodne polarne tekočine. Nepolarne tekočine: klasifikacija, donorsko in akceptorsko število	The liquid state of matter: classes of liquids, order in liquids, equations of state. Basic physical and chemical properties of liquids: molar mass and molar volume, boiling and freezing points. Thermodynamic properties of pure liquids: thermodynamic of phase equilibria, single-component phase diagrams. Liquids crystals: order in liquid crystals, molecular structure in the mesophase. Polar liquids: dielectric properties, water, structural models of liquid water, non-aqueous polar solvents. Non-polar liquids: classification, donor and acceptor numbers. Solute-solvent interactions: electrostatic interaction, polarization, dispersion forces, repulsion

Klasifikacija interakcij topljenec-topilo: elektrostatske interakcije, polarizacija, disprezijske sile, odbojne interakcije, hidrofobne (»solvofobne«) interakcije. Mešanice neelektrolitov: termodinamske lastnosti tekočih mešanic, idealne in neidealne mešanice, topnost, superkritično stanje. Fazni diagrami večkomponentnih sistemov: fazno pravilo, ravnotežje tekočina–para v binarnih sistemih, ravnotežje trdno-tekoče v binarnih sistemih, ternarni sitemi, porazdelitveni koeficient. Osnovni principi topnosti: parametri topnosti, Hansen-ovi parametri topnosti Mešana topila: dielektrične lastnosti, viskoznost, vpliv mešanih topil na kemijsko ravotežje (selektivna solvatacija, asociacija ionov), donor-akceptor lastnosti Ionske tekočine: struktura, klasifikacija, lastnosti, mešanice ionskih in neionskih tekočin, uporaba.	interactions, hydrophobic ("solvophobic") interactions. Mixtures of non-electrolytes: thermodynamic properties of liquid mixtures, ideal and non-ideal mixing, solubility, supercritical state. Phase diagrams for multicomponent systems: phase rule, vapour-liquid equilibrium with two components, liquid-solid equilibrium with two components, three-component liquids, partition coefficients. Basic solubility principles: solubility parameters, Hansen parameters. Mixed solvents: dielectric properties, viscosity, the effect of mixed solvents on the chemical equilibria (selective salvation, ion association), donor-acceptor properties. Ionic liquids: structure, classification, properties, mixtures of ionic-and non-ionic liquids, application.

Temeljna literatura in viri / Readings:

Osnovna literatura:

M. Bešter-Rogač, Zapiski predavanj, FKKT, 2018.

J.N. Murrell and A.D. Jenkins, Properties of Liquids and Solutions, 2nd Edition Wiley Interscience, 1997, 250 strani.

Dodatna literatura:

P. Atkins and J. de Paula, Physical Chemistry, 9th Edition, Oxford University Press, 2010, Chapter 17, pp 622-643.

C. Reichard and T. Welton, Solvents and Solvent Effects in Organic Chemistry, 4th Edition, Wiley-VCH, 2010, Chapters 2 and 3, pp. 7-99.

R. Hayes, G. G. Warr, R. Atkin, Structure and Nanostructure in Ionic Liquids, Chem. Rev., 2015, 115, 6357−6426.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je nadgradnja osnovnega znanja fizikalne kemije tekočin in raztopin. Kompetence: Poudarjeno je poznavanje specifičnih lastnosti tekočin in raztopin, ki določajo tudi njihovo uporabo.	The objective of the course is to upgrade the basic knowledge of the physical chemistry of liquids and solutions. Competencies: The knowledge of specific properties, which also determines their use, is emphasized.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Razumevanje lastnosti tekočin in raztopin na molekularnem nivoju ter povezava le-teh z makroskopskimi lastnostmi.	Knowledge and Comprehension Understanding properties of liquids and solutions at both the thermodynamic and molecular level and connection to their macroscopic properties.
Uporaba Večina reakcij (tudi v industrijskem merilu) poteka v tekočem mediju, biokemijski in naravni sistemi so povezani s tekočim stanjem. Predmet bo tako uporaben za različna področja (kemija, biokemija, farmacija, vede o materialih in okolju) pri obravnavi tekočin bodisi praktično v laboratoriju ali kot osnova za razumevanje.	Application Ability to follow the current research in the field of liquids and solutions, to interpret the processes carried out in the liquid state (synthesis, separation) and to solve relevant problems in chemistry, biochemistry, pharmacy, environmental science.
Refleksija Sposobnost razumevanja problematike in sposobnost kreativnega reševanja praktičnih problemov povezanih z tekočinami in raztopinami.	Analysis Ability of understanding and creative solving of practical problems connected with liquids and solutions.
Prenosljive spretnosti Spretnosti izbiranja in uporabe strategij, metod in interpretacije rezultatov povezanih z tekočinami in raztopinami na različnih področjih.	Skill-transference Ability The ability of choosing and application of the strategies, methods and interpretation of data of liquids and solutions in different fields

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji z reševanjem problemov, seminarske naloge	Lectures, seminars with solving of problems, seminar projects

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- pisni izpit	**50%**	-written exam
- seminarska naloga	**50%**	-seminar project
ocene: pozitivno 6-10; negativno 1-5		marks: positive 6-10, negative 5

Reference nosilca / Lecturer's references:

1. TOMAŠ, Renato, TOT, Aleksandar, KUHAR, Jure, **BEŠTER-ROGAČ, Marija**. Interactions in aqueous solutions of imidazolium chloride ionic liquids [CnCnmim][Cl] (n=0, 1, 2, 4, 6, 8) from volumetric properties, viscosity B-coefficients and molecular dynamics simulations. Journal of molecular liquids,.. 2018, 254, 267-271.

2. ZEC, Nebojša, **BEŠTER-ROGAČ, Marija**, VRANEŠ, Milan, GADŽURIĆ, Slobodan. Volumetric and viscosimetric properties of [bmim][DCA] + γγ-butyrolactone binary mixtures. Journal of Chemical Thermodynamics, 2016, 97, 307-314.

3. **BEŠTER-ROGAČ, Marija**, FEDOTOVA, Marina V., KRUČININ, Sergej, KLÄHN, Marco. Mobility and association of ions in aqueous solutions : the case of imidazolium based ionic liquids. PCCP.

Physical chemistry chemical physics .2016, 18, 28594-28605.

4. **BEŠTER-ROGAČ, Marija**, STOPPA, Alexander, BUCHNER, Richard. Ion association of imidazolium ionic liquids in acetonitrile. The journal of physical chemistry. B, Condensed matter, materials, surfaces, interfaces & biophysical, , 2014, vol. 118, no. 5, str. 1426-1435

1. **ŠARAC, Bojan**, HADŽI, San. Analysis of protonation equilibria of amino acids in aqueous solutions using Microsoft Excel. J. Chem. Educ., 2021, 98, 1001-1007.

2. **ŠARAC, Bojan**, BEŠTER-ROGAČ, Marija. The influence of ionic liquids on micellization of sodium dodecyl sulfate in aqueous solutions. Acta Chim. Slov., 2020, 67, 977-984,

3. **ŠARAC, Bojan**, MEDOŠ, Žiga, COGNIGNI, Alice, BICA, Katharina, CHEN, Li-Jen, BEŠTER-ROGAČ, Marija. Thermodynamic study for micellization of imidazolium based surface active ionic liquids in water : effect of alkyl chain length and anions. Colloids Surfa. A, 2017, 532, 609-617.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	INSTRUMENTALNA ANALIZA
Course Title:	INSTRUMENTAL ANALYSIS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**5.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE135

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

Nosilec predmeta / Lecturer: prof. dr. Matevž Pompe /
Dr. Matevž Pompe, Full Professor

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

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

Vsebina:	**Content (Syllabus outline):**
Statistične metode in pristopi pri instrumentalni analizi: kalibracija, linearna regresija, statistični testi, načrtovanje eksperimentov, metode optimizacije. **Elektroanalizne tehnike v analitiki sledov**: voltametrija (DC, PV, DPV SWV), inverzne (stripping) tehnike, voltametrični senzorji. **Radiokemijske metode**: radioaktivni izotopi in značilnosti radioaktivnega sevanja, zakonitosti razpada, aktivacijska analiza in instrumentacija, uporaba aktivacijske analize in radioaktivnih izotopov. **Rentgenska spektrometrija**: nastanek in lastnosti X žarkov, absorpcija in fluorescenca,	**Statistical methods and approaches to instrumental analysis:** calibration, linear regression, statistical tests, experimental design, optimization methods. **Electroanalytical techniques in trace analysis:** voltammetry (DC, PV, DPV, SWV), striping techniques, Voltammetric sensors. **Radiochemical methods:** radioactive isotopes and characteristics of the radiation, radioactive decay, activation analysis and instrumentation, the use of activation analysis and radioisotope- **X-ray spectroscopic methods:** properties and formation of x-rays, absorption and fluorescence, wavelength and energy dispersive

valovno in energijsko-disperzijski analizatorji, značilnosti in uporaba. **Atomska emisijska spektroskopija**: atomizacija in vzbujanje, značilnosti tehnik (OES), interference, občutljivost, meja zaznave, napake) in uporaba. **Atomska absorbcijska spektrometrija**: plamenska in elektrotermična atomizacija, procesi pri atomizaciji, kemijske in spektralne interference, viri napak in korekcije ozadja. **Separacijske metode v analizni kemiji**: ekstrakcije iz trdnih snovi, ekstrakcije na trdni fazi (SPE). Plinska kromatografija, tekočinska kromatografija visoke zmogljivosti, superkritična kromatografija. **Masna spektrometrija:** instrumentacija, načini ionizacije, analiza in detekcija ionov, identifikacija spojin, pomen izotopov. **Napredne tehnike**: kromatografija-masna spektrometrija.	analyzers. **Atomic emission spectroscopy:** atomization and excitation, characteristics of the techniques (OES), interference, sensitivity, detection limit, errors and applications. **Atomic absorption spectrometry**: flame and electrothermal atomization, the atomization processes, chemical and spectral interferences, error sources and background correction. **Separation methods in analytical chemistry:** extraction of solids, solid phase extraction (SPE). Gas chromatography, high performance liquid chromatography, supercritical fluid chromatography. **Mass spetrometrija:** instrumentation, ionisation modes, analysis and ion detection, identification of the substance, the importance of isotopes. **Hyphenated techniques**: chromatography-mass spectrometry.

Temeljna literatura in viri / Readings:

- D.A. Skoog, F. J. Holler, S.R. Crouch, Principles of Instrumental Analysis, 6th Ed., Thomson Brooks Cole, Belmont, 2007;
- Analytical Chemistry A Modern Approach to Analytical Science, Ed. by R. J.- Mermet, M. Otto, M. Valcarcel, Founding Editors: R. Kellner, H.M. Widmer, Wiley - VCH, Weinheim, 2004.
- J.C. Miller and J.N. Miller, Statistics for Analytical Chemistry, 3rd Ed., Ellis Horwood PTR , New York, 1993.

Cilji in kompetence:	**Objectives and Competences:**
V okviru predmeta dobi študent znanje o pomembnejših instrumentalnih tehnikah in pristopih k reševanju zahtevnih analiznih problemov. Spozna analizne značilnosti instrumentalnih tehnik, njihove prednosti in omejitve ter se usposobi za raziskovalno delo in analizo različnih realnih vzorcev.	The course provides the student with knowledge of the important instrumental techniques, and approaches for solving complex analytical problems. One learns about the analytical features of instrumental techniques, their advantages and disadvantages. The student is trained for research work and analysis of complex real samples.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent se seznani s postopki kalibracije in validacije pri posameznih instrumentalnih	<u>Knowledge and Comprehension</u> Students get acquainted with the calibration and validation procedures of individual

metodah in postopkih. Spozna postopke akreditacije in kritičnega vrednotenja merskih rezultatov. Seznani se z analiznimi karakteristikami posameznih instrumentalnih tehnik, spozna uporabo posameznih tehnik v analitiki sledov anorganskih in organskih sestavin ter se usposobi za samostojno in problemsko orientirano delo.	instrumental methods and procedures. Meets the accreditation process and critical evaluation of the measurement results. Pair it with analytical characteristics of individual instrumental techniques, learn about the use of individual techniques in trace analysis of inorganic and organic substances, and is trained for independent and problem-oriented work.
Uporaba Pridobljena znanja so podlaga za samostojno in kreativno raziskovalno delo v analiznih in sinteznih laboratorijih. Usposobi se za merjenje anorganskih in organskih sestavin v širokem razponu koncentracij in za reševanje zahtevnih analiznih problemov na področju kemije, ekologije, analize bioloških vzorcev in materialov.	Application The acquired knowledge represents basis for independent and creative research work in the analysis and synthesis laboratories. They are capable of measuring the organic and inorganic components in a wide concentration range for solving complex analytical problems in chemistry, environment, analysis of biological samples and materials.
Refleksija Študenti se naučijo prednosti in slabosti različnih instrumentalnih metod in so sposobni njihove kritične izbire za reševanje določenega analiznega problema.	Analysis Students learn advantages and disadvantages of various instrumental methods and are capable of their critical selection for solving particular analytical problem.
Prenosljive spretnosti Obvlada izvedbo instrumentalnih meritev na osnovi literaturnih podatkov in znanstvenih člankov, razume pomen validacije in akreditacije. Zna meritve kritično ovrednotiti in merske rezultate predstaviti v ustrezni pisni in ustni obliki. Obvlada problemski in timski pristop k reševanju analiznih problemov.	Skill-transference Ability Students are capable of the execution of instrumental measurements based on literature reports and scientific papers, understand the importance of validation and accreditation. Students are able to critically evaluate the results and present them in written and oral form. They are trained for teamwork and problem solving analytical problems.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in seminarji z aktualno tematiko.	Lectures

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

Reference nosilca / Lecturer's references:

- S. Kose, S. Koral, B. Tufan, **M. Pompe**, A. Ščavničar, D. Kočar. Biogenic amine contents of commercially processed traditional fish products originating from European countries and Turkey. European Food Research and Technology. A, Zeitschrift für Lebensmittel-Untersuchung und -Forschung. 2012, 235, 669-683.
- G. Arh, L. Klasinc, M. Veber, **M. Pompe**. Calibration of mass selective detector in non-target analysis of volatile organic compounds in the air. J. chromatogr. A 2011, 1218, 1538-1543.

- J. Cerar, **M. Pompe**, M. Guček, J. Cerkovnik, J. Škerjanc. Analysis of sample of highly water-soluble T[sub]-symmetric fullerenehexamalonic acid C[sub](66)(COOH)[sub](12) by ion-chromatography and capillary electrophoresis. J. chromatogr. A 2007, 1169, 86-94.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	INSTRUMENTALNE METODE
Course Title:	INSTRUMENTAL METHODS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**5.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE133

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

Nosilec predmeta / Lecturer: prof. dr. Jurij Reščič / Dr. Jurij Reščič, Full Professor
prof. dr. Matija Tomšič / Dr. Matija Tomšič, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Osnove meroslovja Merjenje. Mednarodni sistem enot. Standardi in hierarhija standardov, meroslovne ustanove. Napake pri merjenju. Umerjanje inštrumentov. Sledljivost merilnih priprav do nacionalnih in mednarodnih standardov	**Introduction to metrology** Measuring. Metric system of units. Standards and their hierarchy, metrological institutions. Measuring errors. Calibration of instruments. Traceability of measuring equipment to national and international standards.
Merilni sistem Elementi za zajem, preoblikovanje, ojačenje, prikaz in prenos signala. Blokovna shema instrumenta. Statične in dinamične karakteristike.	**Measuring system** Elements for acquisition, transformation, amplification, display and transfer of a signal. Block diagram of an instrument. Static and dynamic characteristics.
Merjenje osnovnih fizikalnih količin	**Measuring basic physical quantities:**

Mejenje tlaka, temperature, nivoja, pretoka, mase, gostote in relativne vlažnosti.

Optični elementi v spektroskopiji
Izvori in detektorji elektromagnetnega valovanja (RF, IR,VIS, UV) za uporabo v spektroskopiji. Monokromatorji. Stefanov in Beerov zakon.

Elektrika in osnovne električne meritve
Električno polje, tok in prevajanje. Enosmerni in izmenični tok, Kazalčni diagrami. Polprevodniki, energijski pasovi. Tipi uporov in uporovna vezja. Računska obravnava osnovnih elektronskih vezij. RC, RL, RLC vezje in frekvenčni filtri. Amplitudno razmerje.

Magnetno polje
Inštrument na vrtljivo tuljavico (galvanometer). Analogni in digitalni merilniki električnih količin (ampermeter, voltmeter, ohmmeter, Wheatstoneov most, osciloskop). Snov v magnetnem polju. Transformator.

Osnovni polprevodniški elektronski elementi in gradniki elektronskih merilnih instrumentov
Električne komponente in vezja. Dioda in Zenerjeva dioda. Tranzistor, osnovne vezave in aplikacije, tipi tranzistorjev. Usmernik in stabilizator napetosti. Operacijski ojačevalniki in njihova uporaba.

Zajemanje, pretvorba in procesiranje signalov
Digitalizacija. Digitalna elektronika in mikroračunalniki. Prožilniki, števci, A/D in D/A pretvorniki. Logična vezja. Povezava merilnih instrumentov z računalniki.

Signal in šum
Izvori šuma in metode za povečanje razmerja med signalom in šumom.

Instrumenti za merjenje

pressure, level, flow rate, mass, temperature and relative humidity.

Optical elements in spectroscopy
Sources, monochromators and detectors of EM radiation (RF, UV, VIS, IR) used in spectrometers. Stefan's and Beer's law.

Electricity and basic electrical measurements
Electric field, current and conduction. Direct and alternating current, Phasor diagram. Semiconductors, energy bands. Resistor types and resistor circuitry. Numerical consideration of basic electronic circuits. RC, RL, RLC circuit and frequency filters. Amplitude ratio.

Magnetic field
Moving coil meter (galvanometer). Analogue and digital electrical measuring equipment (ammeter, voltmeter, ohmmeter, Wheatstone bridge, oscilloscope). Matter in magnetic field. Transformer.

Basic electronic semiconductor elements and components of electronic measuring instruments
Electrical components and circuits.
Diode and Zener diode. Transistor and basic applications, transistor types. Rectifier and voltage regulator. Operational amplifiers and their basic application.

Data acquisition, conversion and processing
Digitalization. Digital electronics and microcomputers. Triggers, counters, A/D and D/A converters. Logic circuits. Linking measuring instruments with computers.

Signal and noise.
Sources of noise and methods for increasing the ratios between a signal and noise.

Measuring instruments for:
- emission, absorption, polarization, scattering

- emisije, absorpcije, polarizacije, sipanja in uklona svetlobe (UV-VIS spektrofotometer, polarimeter, refraktometer). - Potenciometrija, kulometrija, amperometrija, konduktometrija, pH meter, konduktometer, galvanostat, potenciostat, kulometer, elektrokemijski senzorji. - razmerja m/e (masni spektrometer). - termičnih karakteristik (TGA, DTA, mikrokalorimetrija, DSC in ITC).	and diffraction of light (UV-VIS spectrophotometer, polarimeter, refractometer). - Potentiometry, coulometry, amperometry, conductometry,pH meter, conductometer, galvanostat, potentiostat, coulometer, electrochemical sensors. - m/e ratios (mass spectrometer) - thermal characteristics (TGA, DTA, micro-calorimetry, DSC in ITC).
Osnove regulacije procesov Namen in pomen avtomatske regulacije procesov. Osnovni pojmi in terminologija. Povratna zanka. Odprti in zaprti regulacijski krog. Blokovni diagram, značilni elementi. Standardni signali za prenos informacije v regulacijski zanki. Izvršilni členi: Avtomatski regulirni ventil. Regulirne črpalke. Regulacijski načini Nezvezni (dvo in večpoložajna) in zvezni načini regulacije (proporcionalni, integralni, derivativni in kombinirani).	**Process control basics** Purpose and importance of automatic control processes. Basic concepts and terminology. Feedback loop. Open and closed control loop. Block diagram with typical elements. Standard signals for transmission of information in the control loop. Final control elements: pneumatic control valve and control pumps. Discontinuous (two and multiple position controllers) and continuous controllers: proportional, integral, derivative and combined.

Temeljna literatura in viri / Readings:

- D.A. Skoog, F.J.Holler, T.A. Nieman: Principles of Instrumental Analysis, 5th Ed., Harcourt Brace & Company, Philadelphia, 1998, Izbrana poglavja, 290 od 564 strani.
- A.J. Diefenderfer, B. E. Holton: Principles of Electronic Instrumentation, 3rd Ed., Saunders College Publishing, 1994.

Dodatna literatura:

- H.A. Strobel: Chemical Instrumentation, 3rd Ed., John Wiley & Sons, New York, 1989.
- Hobart H. Willard, Lynne L. Merritt,Jr., John A. Dean, Frank A. Settle, Jr.: Instrumental Methods of Analysis, 7th Ed., Wadsworth Publishing Company, Belmont, 1988.

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

Cilj predmeta je posredovati slušateljem znanja potrebna za razumevanje delovanja in pravilno rokovanje z modernimi aparaturami v kemijskem laboratoriju. **Kompetence**: Razumevanje vloge in lastnosti funkcionalnih sklopov instrumentov, ki sodelujejo pri nastanku informacije o merjeni količini, njenem preoblikovanju in posredovanju uporabniku. Podrobneje so obdelani elektrokemijski in optični instrumenti.	*Objectives:* Providing the knowledge necessary for understanding the function and correct handling with modern equipment in a chemical laboratory. *Competences:* Understanding the function and properties of functional units of instruments for measuring quantities, with special emphasis on electrochemical and optical instruments.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Absolvent tega predmeta pozna zgradbo in funkcijo osnovnih merilnih instrumentov in aparatur v kemijskem laboratoriju. Seznanjen je z izvorom in učinkom motečih vplivov na njihovo delovanje in na merski rezultat. Sposoben je odkrivanja in preprečevanja napak pri merjenju.	Knowledge and Comprehension A student becomes familiar with structure and function of basic instruments and apparatus found in a chemical laboratory. She/he is aware of limits of the instruments and is able to detect and avoid possible errors during measurements.
Uporaba Na pridobljenem znanju temelji pravilna izbira, uporaba in vzdrževanje aparatur v analitskem in raziskovalnem laboratoriju.	Application Acquired knowledge is a cornerstone of correct choice, usage, and maintenance of instruments in a chemical laboratory.
Refleksija Pridobljeno znanje bo lahko uporabil pri ostalih instrumentalnih metodah, ki niso bile posebej obravnavane in pri nadaljnjem študiju.	Analysis Acquired knowledge can be applied to other instrumental techniques not covered during this course.
Prenosljive spretnosti Pridobil in utrdil bo spretnosti pridobljene tudi pri sorodnih predmetih kot so spremljanje in razumevanje strokovne literature, sposobnost kritične ocene rezultatov, strokovnega poročanja in vestnega in natančnega dela.	Skill-transference Ability A student will consolidate the skills learned in the related subjects such as monitoring and understanding of the scientific literature, critical evaluation of results, reporting a professional and conscientious and thorough work.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminar	- Lectures and seminar.

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

Reference nosilca / Lecturer's references:

- BONČINA, Matjaž, LAH, Jurij, REŠČIČ, Jurij, VLACHY, Vojko. Thermodynamics of the lysozyme-salt interaction from calorimetric titrations. *J. Phys. Chem., B Condens. mater. surf. interfaces biophys.*, **2010**, vol. 114, no. 12, str. 4313-4319.

- BONČINA, Matjaž, REŠČIČ, Jurij, VLACHY, Vojko. Solubility of lysozyme in polyethylene glycol-electrolyte mixtures : the depletion interactions and ion-specific effects. *Biophys. J.*, **2008**, vol. 95, no. 3, str. 1285-1294.

- ZALAR, Petra, TOMŠIČ, Matija, JAMNIK, Andrej, REŠČIČ, Jurij. Osmometry and small-angle x-ray scattering of human serum albumin in buffer solutions. *Acta chim. slov.*, **2006**, vol. 53, št. 3, str. 344-349.

- TOMŠIČ, Matija, CERAR, Jure, JAMNIK, Andrej. Characterization of the supramolecular assembly in 1,4-butanediol. Journal of molecular liquids, 2018, vol. 259, str. 291-303.

- DOGŠA, Iztok, CERAR, Jure, JAMNIK, Andrej, TOMŠIČ, Matija. Supramolecular structure of methyl cellulose and lambda- and kappa-carrageenan in water : SAXS study using the string-of-beads model. Carbohydrate polymers, 2017, vol. 172, str. 184-196.

- TOMŠIČ, Matija, PROSSNIGG, Florian, GLATTER, Otto. A thermoreversible double gel : characterization of a methylcellulose and κ-carrageenan mixed system in water by SAXS, DSC and rheology. Journal of colloid and interface science, 2008, vol. 322, no. 1, str. 41-50.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	KEMIJA HETEROCIKLIČNIH SPOJIN
Course Title:	CHEMISTRY OF HETEROCYCLIC COMPOUNDS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI9

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

Nosilec predmeta / Lecturer: doc. dr. Uroš Grošelj / Dr. Uroš Grošelj, Assistant Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Struktura, nomenklatura in lastnosti heterociklov. Sistematika osnovnih sistemov (velikost, število, in povezava obročev, stopnja nasičenja). Heteroaromati: tavtomerija in valenčne izomerizacije. Nasičeni sistemi: napetost malih obročev, konformacijske značilnosti in analiza, anomerni efekt. **Sinteza heterociklov.** Ciklizacije (ciklosubstitucije, ciklokondenzacije, cikloadicije). Značilni gradniki za sintezo heterociklov. Baldwinova pravila. **Pretvorbe heterociklov.** Reakcije z elektrofili in nukleofili. Odpiranja in pretvorbe obročev. Metaliranje heterociklov. S paladijem katalizirane reakcije. Periciklične reakcije. **Pregled kemije osnovnih tipov heterociklov.**	**Structure, nomenclature, and properties of heterocyclic compounds:** Systematic survey on heterocycles (ring size, number of rings, connection of rings). Heteroaromatic systems: tautomerism and valence isomerisation. Saturated heterocycles: ring strain in small rings, conformational properties and analysis, anomeric effect. **Synthesis of heterocycles.** Cyclisations (cyclosubstitutions, cyclocondensations, cycloadditions). Typical building blocks in the synthesis of heterocycles. Baldwin rules. **Transformations of heterocylces.** Reactions with electrophiles and nucleophiles. Ring-opening and ring-transformations. Metallation of heterocycles. Palladium in heterocyclic

Piridini, kinolini in izokinolini. Diazini. Piroli in indoli. Furani in tiofeni. 1,2- in 1,3-diazoli. Heterocikli s tremi in več heteroatomi. Heterocikli z mostnim dušikovim atomom. **Pomen heterociklov v kemiji, biokemiji in farmaciji.**	chemistry. Pericyclic reactions. **Survey on the chemisty of fundamental heterocyclic systems.** Pyridines, quinolines, and isoquinolines. Pyrroles and indoles. Furans and thiophenes. 1,2- and 1,3-diazoles. Systems with three or more heteroatoms. Systems with a bridgehead nitrogen atom. **Importance of heterocycles in chemistry, biochemistry, and pharmacy.**

Temeljna literatura in viri / Readings:

- A. Joule, K. Mills: Heterocyclic Chemistry At A Glance, 2nd Edition, John Wiley & Sons, 2013, 230 strani.

Dodatna literatura:

- Comprehensive Heterocyclic Chemistry III, A. R. Katritzky, C. A. Ramsden, E. F. V. Scriven, R. J. K. Taylor eds., Elsevier Science, Oxford 2008. (izbrana poglavja).
- Pregledni članki, ki pokrivajo posamezne vsebine iz heterociklične kemije (praviloma v zadnjih 10 letih).

Cilji in kompetence:	**Objectives and Competences:**
Heterociklične spojine predstavljajo zelo pomemben del organske kemije, farmacije in biokemije, saj igrajo bistveno vlogo v osnovnih življenjskih procesih. **Cilj**: Študent se v okviru tega predmeta seznani s sintezami in pretvorbami heterocikličnih sistemov kot pomembnih gradnikov v organski kemiji, biokemiji in farmaciji. **Kompetence**: Poznavanje in uporaba heterocikličnih spojin kot intermediatov v organski sintezi.	Due to essential role of heterocyclic compounds in biological processes, these compounds represent an important topic in chemistry, biochemistry, and pharmacy. ***Objectives:*** The expected learning outcomes are knowledge and understanding of the synthesis and typical reactivity and transformations of heterocycles as well as their use as building blocks in organic chemistry, biochemistry, and pharmacy. ***Competences:*** Knowledge of heterocyclic compounds and their application as intermediates in organic synthesis.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent se nauči: - sinteze in pretvorbe osnovnih heterocikličnih sistemov s posebnim poudarkom na sistemih, ki so pomembni v organski sintezi in biokemiji - pretvorbe in premestitve heterocikličnih sistemov, ki so zlasti pomembne v organski sintezni kemiji - uporabnost hetrocikličnih N-oksidov v sintezni kemiji - elektrofilne in nukleofilne substitucije	<u>Knowledge and Comprehension</u> The student learns*:* -syntheses and transformations of basic heterocyclic systems with emphasis on systems relevant for organic synthesis and biochemistry - transformations and rearrangements of heterocyclic systems relevant in organic synthesis - application of heterocyclic N-oxides in synthetic chemistry - electrophilic and nucleophilic substitutions,

- reaktivnost petčlenskih in šestčlenskih heterociklov, podobnosti in razlike - selektivne reaktivnosti, transformacije funkcionalnih skupin	- reactivity of five- and six-membered heterocycles, similarity and differences, - selective reactivity, transformations of functional groups
Uporaba Poznavanje heterociklične kemije je eden od temeljev organske kemije, zlasti v sintezni organski kemiji, kjer služijo heterocikli mnogokrat kot reaktivni intermediati. To znanje služi poleg tega še vrsti drugih področij, predvsem biokemiji in farmacevtski industriji, kemiji kompleksov z anorganskimi ioni, itd.	Application The knowledge of heterocyclic chemistry belongs to fundamentals of organic chemistry, especially in synthetic organic chemistry, where heterocyclic compounds are frequently used as reactive intermediates. This knowledge is also essential in other related fields, such as biochemistry, pharmaceutical chemistry, and coordination chemistry etc.
Refleksija Predmet je osnova za delo na ostalih področjih kemije predvsem nekaterih predmetov izbirnega sklopa organske kemije in biokemije. Posebnega pomena je tovrstno znanje za delo v kemijski in farmacevtski industriji	Analysis Knowledge of heterocyclic chemistry is required for practical work in other areas of chemistry. It is also useful if not a prerequisite for elective courses from various specialized topics in organic chemistry. This knowledge is of vital importance for those working in chemical and pharmaceutical industry.
Prenosljive spretnosti Znanje heterociklične kemije zagotavlja zaradi prisotnosti heteroatomov v organskem skeletu najširše strukturne in reakcijske možnosti na celotnem področju kemije.	Skill-transference Ability Due to presence of heteroatoms in organic structure, the knowledge of heterocyclic chemistry gives wide structural and reaction possibilities within the whole area of chemistry.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja; seminarji, individualni in skupinski projekti, laboratorijske vaje, individualni in skupinski sintezni projekti.	Lectures,seminars, seminar projects, and laboratory trainings

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

Reference nosilca / Lecturer's references:

1. E. Pušavec Kirar, M. Drev, J. Mirnik, U. Grošelj, A. Golobič, G. Dahmann, F. Požgan, B. Štefane, J. Svete, Synthesis of 3D-Rich Heterocycles: Hexahydropyrazolo[1,5-a]pyridin-2(1H)-ones and Octahydro-2H-2a,2a1-diazacyclopenta[cd]inden-2-ones, J. Org. Chem. 2016, 81, 8920–8933. DOI: 10.1021/acs.joc.6b01608. [COBISS.SI-ID 1537115331]
2. U. Grošelj, E. Pušavec, A. Golobič, G. Dahmann, B. Stanovnik, J. Svete, Synthesis of 1,5-

disubstituted-4-oxo-4,5-dihydro-1H-pyrazolo[4,3-c]pyridine-7-carboxamides, Tetrahedron 2015, 71, 109–123. DOI: 10.1016/j.tet.2014.11.034. [COBISS.SI-ID 1536061891]
3. U. Grošelj, A. Beck, W. B. Schweizer, D. Seebach, Preparation and Structures of 2-Substituted 5-Benzyl-3-methylimidazolidin-4-one-Derived Iminium Salts, Reactive Intermediates in Organocatalytic Transformations Involving α,β-Unsaturated Aldehydes, Helv. Chim. Acta 2014, 97, 751–796. DOI: 10.1002/hlca.201400110. [COBISS.SI-ID 1536179139]
4. U. Grošelj, M. Žorž, A. Golobič, B. Stanovnik, J. Svete, α-Amino acid derived enaminones and their application in the synthesis of N-protected methyl 5-substituted-4-hydroxypyrrole-3-carboxylates and other heterocycles, Tetrahedron 2013, 69, 11092–11108. DOI: 10.1016/j.tet.2013.11.008. [COBISS.SI-ID 1650735]
5. U. Grošelj, A. Podlogar, A. Novak, G. Dahmann, A. Golobič, B. Stanovnik, J. Svete, Synthesis of tetrahydropyrazolo[1,5-c]pyrimidine-2,7(1H,3H)-diones, Synthesis 2013, 45, 639–650. DOI: 10.1055/s-0032-1318107. [COBISS.SI-ID 36543749]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	KEMIJA OKOLJA
Course Title:	ENVIRONMENTAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**4.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI3

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

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

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
1. Splošni pojmi, lastnosti troposfere, stratosfere. 2. Nastanek, pretvorbe in transport atmosferskih onesnaževal (trdni delci, CO, CO2, SO2, NOx, O3, ogljikovodiki). Pojav ozonskih lukenj in tople grede. Posledice onesnaževanja atmosfere (kisel dež, pojav mračenja). Ukrepi za zmanjšanje onesnaževanja. 3. Površinske in podtalne vode. Kemija in biokemija onesnaževal v hidrosferi. Razgradljiva in nerazgradljiva onesnaževala voda in njihov vpliv na zdravje ljudi. Ukrepi za zmanjševanje onesnaženja voda. 4. Zemlja in glavna onesnaževala. Problem	1. General concepts, properties of troposphere and stratosphere. 2. Sources, transformations and transport of atmospheric pollutants (particulate matter, CO, CO2, SO2, NOx, O3, hydrocarbons). Ozone hole and greenhouse phenomena. Atmospheric pollution consequences (acid rain, dimming). Measures to decrease pollution. 3. Surface and ground water. Chemistry and biochemistry of pollutants in hydrosphere. Degradable and non-degradable pollutants of waters, their influence on public health. Measures to decrease water pollution. 4. Soil and its principal pollutants. Role of nitrates and phosphates in surface waters and

nitratov in fosfatov v površinskih vodah in nitratov v podtalnici. Obstojna kemijska onesnaževala (klorirane spojine, policiklični aromati, fitofarmacevtska sredstva, kovine) in njihova usoda v okolju. 5. Trdni odpadki - viri. Problemi z odlagališči in sežiganjem odpadkov. 6. Energija in okolje. Jedrska energija in radioaktivni odpadki. 7. Določanje splošnih in specifičnih onesnaževal. Vzorčenje in tehnike priprave okoljskih vzorcev. Hitri testi in senzorji za spremljanje onesnaženja okolja. Analitske tehnike za določanje organskih in anorganskih onesnaževal v atmosferi, v vodah in v zemlji. 8. Ukrepi za zmanjševanje onesnaženja okolja. Laboratorijske vaje: določanje onesnaževal v vzorcih zraka, vode in tal z različnimi analiznimi tehnikami.	nitrates in ground waters. Stable chemical pollutants (chlorinated compounds, polycyclic aromatics, phytopharmaceuticals, metals) and their environmental fate. 5. Solid waste - sources. Problematic issues of landfills and waste incinerators. 6. Energy and environment. Nuclear energy and radioactive waste. 7. Determination of general and specific pollutants. Sampling and sample preparation techniques for environmental samples. Rapid tests and sensors for pollution monitoring. Analytical techniques for organic and inorganic pollutant determination in atmosphere, water and soil. 8. Measures to decrease environmental pollution. Laboratory work: pollutant determination in atmospheric, aqueous and soil samples with different analytical techniques.

Temeljna literatura in viri / Readings:

Temeljna literatura:

- G.W. vanLoon, S.J. Duffy: Environmental Chemistry, 3rd ed., Oxford Univ. Press, Oxford UK, 2011, 545 str.
- G. Fellenberg: The Chemistry of Pollution, Wiley 2000, 192 str. (20%)
- B.B. Kebbekus, S.Mitra: Environmental Chemical analysis, Blackie Academic&Profesional, London 1998, 330 str. (30%)

Dopolnilna literatura:

- F.W. Fifield, P.J. Haines (eds.): Environmental Analytical Chemistry, 2nd ed., Blackwell Science, Oxford UK, 2000
- J.E. Girard: Principles of Environmental Chemistry, 2nd ed., Jones and Bartlett Publ., Sudbury, MA, USA, 2010
- znanstveni in strokovni članki (scientific and professional articles)

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Predstaviti študentom glavna onesnaževala atmosfere, vod in zemlje, njihove vplive na okolje in njihovo analitiko v okoljskih vzorcih **Kompetence**: Sposobnost razumevanja osnovnih okoljskih dejstev; sposobnost opazovanja različnih pojavov; sposobnost predstavitve določenih okoljskih problemov ustno in v pisni obliki; sposobnost razreševanja konkretnih okoljskih problemov, sposobnost izbire ustrezne tehnike priprave	**Objectives:** To inform the students about the principal pollutants in atmosphere, water and soil; their influence on the environment; analytical determination in environmental samples. **Competences:** Ability to understand basic environmental facts; ability to observe diverse phenomena; ability to present selected environmental problems in oral and written form; ability to solve particular environmental problems; ability to select an appropriate sample preparation and analytical technique for

vzorca in analize za različna onesnaževala.	different pollutants.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent bo spoznal osnovna okoljska onesnaževala. Iz lastnosti okoljskih onesnaževal, ki jih je že delno spoznal pri drugih predmetih, lahko oceni njihov vpliv na kvaliteto okolja. Iz predstavljenih procesov za zmanjševanje emisij bo znal oceniti mejne vrednosti posameznih onesnaževal v okolju in jih pravilno določiti s primerno analizno tehniko.	Knowledge and Comprehension Student will be informed about principal environmental pollutants. They can evaluate their influence on environment quality from their properties, which were in part introduced in other courses. Limit values of certain pollutants in the environment will be evaluated from the presented processes for emission lowering and accurately determined by an appropriate analytical technique.
Uporaba Študent je sposoben kritično ovrednotiti vpliv posameznega onesnaževala na okolje in oceniti nevarnost, ki jo predstavlja za ljudi.	Application Student is able to critically evaluate the influence of particular pollutant on the environment and assess the risk for the population.
Refleksija Študent bo pridobil tudi določen občutek za kritično oceno kvalitete okolja.	Analysis Student will gain a certain ability to critically evaluate the environmental quality.
Prenosljive spretnosti Študent bo znal uporabljati osnovne analizne metode za hitro določanje onesnaževal. Na osnovi teh meritev in njihove kritične ocene bo lahko sklepal o onesnaženosti okolja.	Skill-transference Ability Student will be able to apply basic analytical methods for rapid pollutant determination. They will be able to assess the environmental pollution, based on these measurements and their critical evaluation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijske vaje, delo na terenu.	Lectures, seminars, laboratory work, field work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- pisni izpit (poz. ocena 6-10), - seminarska naloga - laboratorijske vaje	**60 %** **30 %** **10 %**	- written exam (pass grade 6-10), - seminar coursework, - laboratory work

Reference nosilca / Lecturer's references:

1. PROSEN, Helena, ZUPANČIČ-KRALJ, Lucija. Evaluation of photolysis and hydrolysis of atrazine and its first degradation products in the presence of humic acids. Environ. pollut. (1987) 2005, vol. 133, no. 3, 517-529.
2. PROSEN, Helena, FINGLER, Sanja, ZUPANČIČ-KRALJ, Lucija, DREVENKAR, Vlasta. Partitioning of selected environmental pollutants into organic matter as determined by solid-phase microextraction. Chemosphere (Oxford). 2007, vol. 66, no. 8, 1580-1589.

3. KRALJ CIGIĆ, Irena, PROSEN, Helena. An overview of conventional and emerging analytical methods for the determination of mycotoxins. Int. J. Mol. Sci. 2009, vol. 10, no. 1, 62-115.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	KEMIJA ZA TRAJNOSTNI RAZVOJ
Course Title:	CHEMISTRY FOR SUSTAINABLE DEVELOPMENT

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.** in **3.**	**4.** in **6.**
USP Chemistry, 1st Cycle	**/**	**2nd** and **3rd**	**4th** and **6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI5

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

Nosilec predmeta / Lecturer: Prof. dr. Urška Lavrenčič Štangar /
Dr. Urška Lavrenčič Štangar, Full Professor

Jeziki / Languages:

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

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

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

Prerequisites:

The course has to be assigned to the student.

Vsebina:

PREDAVANJA

Potrebe po trajnostnem pristopu v kemiji, biokemiji in kemijskem inženirstvu. Nekaj primerov slabe kemijske prakse iz preteklosti, nesreče v kemijski industriji.

Osnovnih 12 principov trajnostnega razvoja in **zelene kemije**: preprečevanje nastajanja odpadkov, stehiometričnost sinteznih metod, zmanjšanje toksičnosti za ljudi in okolje, zmanjševanje pomožnih substanc, minimiziranje energetskih potreb, možnost recikliranja materialov, zmanjšanje uporabe intermediatov, prednosti uporabe katalizatorjev, pomen biorazgradljivosti materialov, monitoring nevarnih snovi.

Content (Syllabus outline):

LECTURES

The need for achieving sustainability in chemistry, biochemistry and chemical engineering. Examples of bad chemistry from the past, accidents in chemical industry.

Basic 12 principles of **green chemistry**: waste prevention, incorporation of all materials into the final product, reduction of toxicity, reduction of auxiliary substances, synthesis at ambient temperature and pressure, minimizing energy requirements, catalytic reagents, recycling of materials, biodegradable materials, monitoring of pollutants.

Selected examples of the application of sustainability principles in everyday life.

Primeri uporabe principov trajnostnega razvoja v vsakdanjem življenju. **Plastika, bioplastika**: prednosti in slabosti obeh materialov, pridobivanje, odlaganje odpadkov, biorazgradljivost, kompostiranje, okoljski vplivi obeh materialov, mikroplastika v oceanih. **Obnovljivi viri energije**: izkoriščanje sončne energije, fotovoltaika, barvno občutljive sončne celice (elektrokemijske), ogljični odtis, primerjava različnih tehnologij, prednosti, slabosti. **Gorivne celice in vodikova ekonomija**: pridobivanje vodika, skladiščenje vodika, pretvorba vodika v gorivnih celicah, družbena sprejemljivost. **Biogoriva**: lesna biomasa, alge, biodizel, biomasa, anaerobna razgradnja. **Fotokataliza**: kemizem fotokatalize s TiO_2, organska onesnažila v okolju in možnosti njihove razgradnje, prednosti, slabosti katalitskih postopkov pri mineralizaciji onesnažil. **Ekskurzija**: na temo ravnanja z odpadki (obisk deponije ali čistilne naprave) ali trajnostnih virov energije (obisk hidroelektrarne, jedrske elektrarne) ali primera dobre kemijske prakse. **SEMINAR** V okviru seminarja študent izbere aktualno temo in jo predstavi pred skupino. Obvezna vsebina seminarja: prikaz kemijskih osnov problema s stališča 12 principov trajnostnega razvoja, predlogi za reševanje problema. Diskusija. **VAJE** Vsaka eksperimentalna vaja je mini raziskovalno delo. Sinteza biodizla Recikliranje PET Bioplastika Priprava TiO_2 kot katalizatorja Fotokatalitično delovanje TiO_2 Sončne celice	**Plastics, bioplastics**: advantages and disadvantages of both materials, production, depositing of waste, biodegrability, composting, environmental influences, microplastics in the oceans. **Renewable energy resources**: harvesting solar energy, photovoltaics, dye sensitised solar cells, carbon footprint, comparison of different technologies, advantages, disadvantages. **Fuel cells and hydrogen economy**: hydrogen production, storage, fuel cells operation, social acceptance. **Biofuels**: wood biomass, algae, biodisel, biomass, anaerobic digestion. **Photocatalysis**: mechanism of TiO_2-photocatalysis, organic pollutants in environment and their degradation, advantages, disadvantages of catalytic mineralization. **Excursion**: on the topic of waste management (visit of a landfill or waste water treatment plant) or sustainable energy technologies (visit of hydro, nuclear power plant) or good chemical practice. **SEMINAR** Each student chooses a topic related with the sustainable development, environmental chemistry and green chemistry and prepare non-research project work. In the project the problem should be discussed regarding the 12 principles of green chemistry, proposed solution. Discussion. **PRACTICAL WORK** Each topic is a mini research laboratory project work. Biodiesel synthesis Recycling of PET Bioplastics Preparation of TiO_2 photocatalyst Photocatalytic activity of titanium dioxide Solar cells

Temeljna literatura in viri / Readings:

1. M. Lancester: Green Chemistry: An Introductory Text, 3. izdaja, The Royal Society of Chemistry, 2016
2. Sustainable Energy Technologies: Options and Prospects, ed. K. Hanjalić, R. van de Krol, A.

Lekić, Springer, Dordrecht, 2008.
3. Renewable Energy, ed. G. Boyle, Oxford University Press, 2012.
4. S. Medved in C. Arkar: Energija in okolje: obnovljivi viri energije, Univerza v Ljubljani, Zdravstvena fakulteta, 2009.

Y. Nosaka, A. Nosaka: Introduction to Photocatalysis: from basic science to applications, Royal Society of Chemistry, Cambridge, 2016.

Cilji in kompetence:

Cilj predmeta: Cilj predmeta je študentom razvijati zavedanje o pomenu vključevanja principov trajnostnega razvoja v vsa aplikativna področja kemije in sorodnih ved, razvijati zmožnosti za razumevanje kemijskih osnov pri aplikacijah v kemiji, biokemiji in kemijskem inženirstvu, razvijati sposobnosti za presojo vpliva kemijskih reakcij na živo in neživo naravo.

Predmetno specifične kompetence:

Aktivno poznavanje principov trajnostnega razvoja.

Razumevanje kemijskih osnov heterogenih reakcij v procesnih aplikacijah. Razumevanje kemijskih osnov toksičnega delovanja kovinskih in nekovinskih zvrsti.

Usposobljenost za razumevanje vpliva kemijskih procesov na okolje.

Razumevanje kemijskih principov remediacije okolja.

Usposobljenost za uporabo principov trajnostnega razvoja pri reševanju kemijskih problemov.

Objectives and Competences:

To study the principles of sustainable development in the chemistry and related sciences.

- Students will develop knowledge and understanding of applications and uses of chemistry in different areas.
- To comprehend the basic principles of sustainable development in chemistry, biochemistry and chemical engineering.
- To develop abilities for estimation of influences of chemical reactions on the environment.
- To use and apply the principles of sustainable development.
- To consolidate the necessary knowledge in the process applications.
- To understand the chemistry of metal and non-metal species.
- To understand and estimate the influences of specific chemical reactions on the environment
- To understand the principles of chemical remediation
- To use the principles of sustainable development in solving of chemical problems

Predvideni študijski rezultati:

Znanje in razumevanje

Študent spozna osnovne principe trajnostnega razvoja ter možnosti kemije pri razumevanju in upoštevanju teh principov. Spozna in razume kemijske osnove škodljivih vplivov na človeka in okolje.

Uporaba

Zna uporabiti znanje kemije pri vrednotenju vplivov na človeka in okolje. Na praktičnih primerih uporabe v praksi se nauči vrednotiti omenjene vplive ter iskati ustrezne rešitve.

Intended Learning Outcomes:

Knowledge and Comprehension

- To be able to use the basic principles of sustainable development in the area of chemistry.
- To be able to understand the chemistry of harmful influences on human and environment

Application

Be able to use the proficiency in evaluating the influences on the human and environment and find the optimal solution.

Refleksija Študent bo na seminarjih analiziral izbrano temo, pri čemer bo uporabil principe trajnostnega razvoja za iskanje rešitev konkretnih problemov.	Analysis Each student analyses a selected topic chosen at seminars and be able to understand and use principles of sustainable development in the specific problem.
Prenosljive spretnosti Sposobnost uporabe domačih in tujih virov literature in baz podatkov, interpretacije in prikaza podatkov, kritična presoja in delo v skupini.	Skill-transference Ability Ability of usage the literature data, interpretation of data, critical analysis of texts relating the topics and team work.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predmet se izvaja v obliki projektnega dela. Študenti izberejo določeno temo, identificirajo ključne probleme ter poiščejo in predlagajo rešitve. Hkrati nekatere primere spoznajo tudi v praksi.	Project work. Each student chooses a specific topic related with the sustainable development (sustainable chemistry), identifies the key problems and suggests the possible solutions. Oral presentation and discussion.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Seminarska naloga (20 %) Izvedba in predstavitev eksperimentalnega projekta (20 %) Pisni izpit (60 %) Skupna ocena mora biti 6 ali več		Seminar project (20%) Realisation and presentation of Experimental project (20%) Written exam (60 %) Total mark 6 or more

Reference nosilca / Lecturer's references:

1. VODIŠEK, Nives, RAMANUJACHARY, Kandalam, BREZOVÁ, Vlasta, LAVRENČIČ ŠTANGAR, Urška. Transparent titania-zirconia-silica thin films for self-cleaning and photocatalytic applications. Catal. Today 287 (2017) 142-147.
2. CARRARO, Giorgio, MACCATO, Chiara, GASPAROTTO, Alberto, WARWICK, Michael E. A., SADA, Cinzia, TURNER, Stuart, BAZZO, Antonio, ANDREU, Teresa, PLIEKHOVA, Olena, KORTE, Dorota, LAVRENČIČ ŠTANGAR, Urška, VAN TENDELOO, Gustaaf, MORANTE, Juan Ramón, BARRECA, Davide. Hematite-based nanocomposites for light-activated applications: synergistic role of TiO_2 and Au introduction. Solar Energy Mater. Solar Cells 159 (2017) 456-466.
3. ŠULIGOJ, Andraž, LAVRENČIČ ŠTANGAR, Urška, RISTIĆ, Alenka, MAZAJ, Matjaž, VERHOVŠEK, Dejan, NOVAK TUŠAR, Nataša: TiO_2-SiO_2 films from organic-free colloidal TiO_2 anatase nanoparticles as photocatalyst for removal of volatile organic compounds from indoor air. Appl. Catal. B Environ. 184 (2016) 119-131.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	KEMIJSKA ANALIZA ŽIVIL
Course Title:	CHEMICAL ANALYSIS OF FOODSTUFFS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: 0640062

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

Nosilec predmeta / Lecturer: prof. dr. Irena Kralj Cigić / Dr. Irena Kralj Cigić, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
1. Analizne metode za ugotavljanje vsebnosti osnovnih sestavin živil: vlaga, proteini, sladkorji, maščobe. 2. Klasične analizne metode (gravimetrija, volumetrija) v kombinaciji z ekstrakcijo, destilacijo, obarjanjem 3. Instrumentalne metode: (IR, molekulska spektrometrija, GC, HPLC). 4. Določanje anorganskih mikrokomponent v živilih . Razkroj vzorcev. 5. Spektroskopske metode za določanje sledov kovin in organskih spojin 6. Organske mikrokomponente v živilih: uporaba kromatografskih metod z različnimi detektorji. 7. Določanje sestavin arom	1. Analytical methods for the determination of basic ingredients in foodstuffs: moisture, proteins, sugars, lipids. 2. Classical analytical methods (gravimetry, volumetry) in combination with extraction, distillation, precipitation. 3. Instrumental methods: infrared and molecular spectrometry, gas and liquid chromatography. 4. Determination of inorganic microcomponents and digestion of the samples. 5. Spectroscopic methods for the determination of trace metals and trace organic compounds. 6. Determination of organic microcomponents

8. Metode za izolacijo spojin iz posameznih živil: ekstrakcija s topili, ekstrakcija na trdno fazo, mikroekstrakcija, ekstrakcija iz plinske faze, mikrovalovna ekstrakcija, ekstrakcija s superkritično tekočino itd., 9. Izbira analizne metode, presejalne metode, hitri testi 10. Vrednotenje rezultatov analiz in validacija analiznih metod.	by chromatographic methods with various detectors. 7. Determination of aroma constituents. 8. Isolation methods from selected foodstuffs: solvent extraction, solid-phase extraction, microextraction, headspace extraction, microwave extraction, supercritical fluid extraction, etc. 9. Choice of an analytical method, screening methods, rapid screening assays. 10. Evaluation of analytical results and validation of analytical methods.

Temeljna literatura in viri / Readings:

- Navodila za vaje pri predmetu Kemijska analiza živil, H. Prosen, I. Kralj Cigić, UL FKKT, 2006.
- Food Analysis, S.S. Nielsen, 4th ed.,Springer, New York, 2010.

Dodatna literatura:

- AOAC – standardni postopki za analizo živil
- Članki iz znanstvenih in strokovnih revij

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje poznajo in znajo uporabljati analizne metode, ki se uporabljajo za ugotavljanje sestave in spremljanje kvalitete živil. Študentje si pri predmetu pridobijo naslednje specifične kompetence: - zmožnost izbire najprimernejšega analiznega pristopa za določanje glavnih in mikrokomponent živil - zmožnost praktične uporabe primernega analiznega pristopa za določanje specifičnih sestavin živil v laboratoriju - zmožnost poiskati v razpoložljivi primarni in sekundarni literaturi problemu primerno analizno metodo/postopek - kritično vrednotenje rezultatov, dobljenih z apliciranimi metodami/postopki - zmožnost, da izboljšajo in razvijejo nove analizne metode in postopke - usposobljenost za pisanje poročil, kritično vrednotenje in interpretacijo eksperimentalnih rezultatov	**Learning outcomes:** Understanding and application of analytical methods for the determination of ingredients and quality screening of the foodstuffs. **Competences:** -ability to choose the appropriate analytical technique for determination of macro- or micro- components of foodstuffs -ability of practical application of suitable analytical procedure for determination of specific food ingredients in the laboratory -ability to find the appropriate method/procedure in primary and secondary literature -critical evaluation and interpretation of experimental results -ability to develop or improve analytical methods and procedures -preparation of analytical report, critical evaluation and interpretation of experimental data.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študenti spoznajo glavne analizne metode za določanje makro- in mikrosestavin živil in jih znajo kritično uporabiti: poznajo prednosti in omejitve posameznih metod, motnje, vire napak.	Knowledge and Comprehension To gain knowledge about main analytical methods for determination of macro- and micro- components of foodstuffs and to critically perform them: advantages and limitations of specific methods, interferences, sources of errors.
Uporaba Študenti znajo izbrati in v laboratoriju uporabiti primerne analizne metode. Znajo rokovati z enostavnejšimi analiznimi inštrumenti.	Application To choose and perform suitable analytical method in the laboratory. To handle with simple analytical instruments.
Refleksija Študentje kritično ovrednotijo analizne metode, prav tako tudi rezultate, ki jih dobijo z njihovo uporabo.	Analysis To critically evaluate different analytical methods and also evaluation of results. To handle simple analytical instruments.
Prenosljive spretnosti Študentje se naučijo uporabljati strokovno literaturo, znajo zbrati in interpretirati podatke. Znajo pisati povzetke in pisna poročila ter predstaviti rezultate analiz in raziskav v pregledni obliki.	Skill-transference Ability To use specialised literature, to collect and interpret data. To write abstracts and report and to present analysis results and investigations in transparent form.

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

Načini ocenjevanja:	Deež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu.		Completed laboratory course is prerequisite for the exam.
Kolokvij iz vaj	**40 %**	Test from laboratory course
Pisni izpit	**40 %**	Written exam
Seminarska naloga	**20 %**	Seminar coursework
Ocene: 6-10 (pozitivno), 5 (negativno).		Grades: 6-10 (positive), 5 (negative)

Reference nosilca / Lecturer's references:

1. T. Prevc, A. Levart, I. Kralj Cigić, J. Salobir, N. Poklar Ulrih, B. Cigić. Rapid estimation of tocopherol content in linseed and sunflower oils-reactivity and assay. Molecules. 20 (2015) 14777-14790.

2. A. Marič, M. Skočaj, M. Likar, K. Sepčić, I. Kralj Cigić, M. Grundner, A. Gregori. Comparison of lovastatin, citrinin and pigment production of different Monascus purpureus strains grown on rice and millet. Journal of Food Science and Technology. 56 (2019) 3363-3373.

3. I. Kralj Cigić, S. Rupnik, T. Rijavec, N. Poklar Ulrih, B. Cigić. Accumulation of agmatine,

spermidine, and spermine in sprouts and microgreens of alfalfa, fenugreek, lentil, and daikon radish. Foods. 9 (2020), 1-20.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MAKROMOLEKULARNA KEMIJA
Course Title:	MACROMOLECULAR CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI12

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

Nosilec predmeta / Lecturer: izr. prof. dr. Miha Lukšič / Dr. Miha Lukšič, Associate Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Osnove: Klasifikacija makromolekul. Mehanizmi in načini polimerizacije. Pogosti naravni in sintetični polimeri. Prevodni polimeri, aplikacije v industriji elektronike. **Kinetika reakcij polimerizacije**: Radikalska in kondenzacijska polimerizacija. Vplivi na hitrost reakcije in povprečno kinetično stopnjo polimerizacije. **Statistika linearnih polimerov**: Porazdelitve in povprečja molskih mas polimerov, polidisperznost. Povprečne dimenzije polimerov v raztopini: razdalja od konca do konca, radij sukanja. Naključni klobčič, Kuhnov model. Porazdelitvena funkcija za razdaljo od konca do konca, izključeni volumen.	**Introduction**: Classification of macromolecules. Mechanisms and ways of polymerization. Common natural and synthetic polymers. Conductive polymers, applications in electronics industry. **Kinetics of polymerization reactions**: Radical and condensation polymerization. Influences on the reaction rate and average kinetic degree of polymerization. **Statistics of linear polymers**: Molecular weight distributions and averages, polydispersity. Average dimensions of polymers in solution: end-to-end distance, radius of gyration. Random coil, Kuhn model. Distribution function for end-to-end distance, excluded volume.

Makromolekule v raztopini: Vpliv interakcij segment-segment in segment-topilo na povprečne dimenzije, klasifikacija topil. Koncentracijski režimi. Raztopine nabitih makromolekul, Donnanovo ravnotežje. Fazna ravnotežja, točka zmotnitve. **Eksperimentalne metode karakterizacije**: Analiza končnih skupin, viskoznost, sipanje svetlobe, osmometrija, sedimantacija in difuzija, kromatografija. **Lastnosti polimerov**: Kristaliničnost, amorfnost. Temperatura steklastega prehoda. Osnovni principi razgradnje polimerov.	**Macromolecules in solution**: Influence of the segment-segment and segment-solvent interactions on the average dimensions, solvent classification. Concentration regimes. Solutions of charged macromolecules, Donnan equilibrium. Phase equilibria, cloud point. **Experimental methods for characterization**: End-group analysis, viscosity, light scattering, osmometry, sedimentation and diffusion, chromatography. **Properties of polymers**: Crystallinity, amourphousness. Glass transition temperature. Basic principles of polymer degradation.

Temeljna literatura in viri / Readings:

1. S. Lapajne in C. Pohar, *Makromolekulska kemija*, Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo, 2000.
2. J. M. G. Cowie in V. Arrighi, *Polymers: chemistry and physics of modern materials*, Boca Raton: CRC Press, 2007.
3. S. F. Sun, *Physical chemistry of macromolecules: Basic principles and issues*, New York: John Willey & Sons, 2004.
4. M. D. Lechner, K. Gehrke, E. H. Nordmeier, *Makromolekulare Chemie*

Ein Lehrbuch für Chemiker, Physiker, Materialwissenschaftler und Verfahrenstechniker, Berlin: Springer-Verlag, 2014

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je poglobiti fizikalnokemijska znanja pomembna za aplikativno in osnovno raziskovalno delo na področju makromolekulske oziroma polimerne kemije. **Kompetence**: Poznavanje in uporaba kinetike polimernih reakcij, termodinamskih lastnosti raztopin makromolekul, modernih eksperimentalnih tehnik za karakterizacijo in določanje fizikalnokemijskih lastnosti polimerov.	To obtain the knowledge in physical chemistry of macromolecules needed for further use in basic and applied research. Toward understanding the kinetics of polymer reactions, physico-chemical properties of macromolecules in solution and experimental techniques for their determination.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Slušatelj spozna glavne fizikalnokemijske značilnosti makromolekularnih sistemov, ki omogočajo razumevanje njihovih lastnosti.	Knowledge and Comprehension Students learn basic principles of physico-chemical behaviour of macromolecules in solution and their experimental determination.
Uporaba Pridobljena znanja so pomembna in koristna	Application The knowledge can be applied in further

za uspešno aplikativno in osnovno raziskovalno delo.	research or applicative work in this area of science.
Refleksija Študenti spoznajo tesno povezanost med strukturo in lastnostmi polimernih snovi in med teorijo in eksperimentom.	Analysis Students become aware of the connection between the structure of macromolecule and its properties in solution. The knowledge allows them to correlate theory and experiment.
Prenosljive spretnosti Sposobnost zaznavanja in reševanja problemov, ki zadevajo makromolekularne sistema. Sposobnost samostojnega študija in poročanja o svojem delu in rezultatih.	Skill-transference Ability The ability of problem-solving in chemistry. The experimental methods, used to study macromolecules in solution, can be applied in other areas of research. Increased capability of individual study and presentation of the results in form of the oral and written report.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in seminarji	Lectures and seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ustni in pisni izpit	**100 %**	Oral and written exam

Reference nosilca / Lecturer's references:

- **LUKŠIČ, Miha**, BONČINA, Matjaž, VLACHY, Vojko, DRUCHOK, M. Isothermal titration calorimetry and molecular dynamics study of ion-selectivity in mixtures of hydrophobic polyelectrolytes with sodium halides in water. PCCP. Physical chemistry chemical physics, 2012, 14 (6), 2024-2031
- **LUKŠIČ, Miha**, BUCHNER, Richard, HRIBAR, Barbara, VLACHY, Vojko. Dielectric relaxation spectroscopy of aliphatic ionene bromides and fluorides in water: the role of the polyion's charge density and the nature of the counterions. Macromolecules, 2009, 42 (12), 4337-4342
- RODIČ, Peter, BRATUŠA, Marsel, **LUKŠIČ, Miha**, VLACHY, Vojko, HRIBAR, Barbara. Influence of the hydrophobic groups and the nature of counterions on ion-binding in aliphatic ionene solutions. Colloids and surfaces. A, Physicochemical and Engineering Aspects, 2013, 424 (1), 18-25.

UČNI NAČRT PREDMETA	
Predmet:	MATEMATIKA
Course Title:	MATHEMATICS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemijsko inženirstvo, 1. stopnja, UŠP Biokemija, 1. stopnja, UŠP Kemija, 1. stopnja	**/**	**1.**	**1. in 2.**
USP Chemical Engineering, 1st Cycle, USP Biochemistry, 1st Cycle, USP Chemistry, 1st Cycle	**/**	**1.**	**1st and 2nd**

Vrsta predmeta / Course Type: Obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
90	/	**60 SV**	/	/	**150**	**10**

Nosilec predmeta / Lecturer: izr. prof. dr. Jaka Smrekar / Dr. Jaka Smrekar, Associate Professor
prof. dr. Petar Pavešić / Dr. Petar Pavešić, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
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	**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

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 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.	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. **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:

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 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.)

Objectives and Competences:

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 them an oportunity to acquire basic mathematical skills needed to follow the literature in their own speciality.

Predvideni študijski rezultati:

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.

Intended Learning Outcomes:

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.

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.	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.
Prenosljive spretnosti Predmet daje tudi osnovo za razumevanje nekaterih računalniških postopkov in metod, ki jih bodo spoznali kasneje pri drugih predmetih in ob delu.	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 (v %) / Weight (in %)	**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]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MOLEKULARNE OSNOVE VED O ŽIVLJENJU
Course Title:	MOLECULAR FUNDAMENTALS OF LIFE SCIENCES

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemijsko inženirstvo, 1. stopnja, UŠP Kemija, 1. stopnja	**/**	**1.**	**1.**
USP Chemical Engineering, 1st Cycle, USP Chemistry, 1st Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE105

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

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

Jeziki / Languages:

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

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

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

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Življenje

1. Življenje in vede o življenju.
2. Značilnosti celic: prokarionti in evkarionti. Celična komunikacija.
3. Organi in fiziologija večceličnih organizmov (rastline, živali).
4. Evolucija in filogenija.
5. Organizmi in okolje.

Biološke makromolekule

6. Aminokisline, peptidi in proteini.
7. 3D zgradba proteinov in njihova biološka vloga.
8. Encimi: reakcije, kinetika, inhibicija,

Content (Syllabus outline):

Life

1. Life and life sciences.
2. Cells: prokaryotes and eukaryotes. Cellular communicaion.
3. Organs and physiology of multicellular organisms (plants, animals).
4. Evolution and phylogeny.
5. Organisms and the environment.

Biological macromolecules

6. Amino acids, peptides and proteins.
7. Proteins – three-dimensional structure and biological function.

koencimi. 9. Ogljikovi hidrati: zgradba in biološka vloga. 10. Lipidi, biološke membrane in transport. 11. DNA in RNA: zgradba in vloga. **Molekularne osnove celičnih procesov** 12. Ohranjanje in prenos biološke informacije. 13. Rekombinantna DNA in biotehnologija. 14. Celični ciklus in celična smrt. Oksidativni stres. Rak. 15. Osnove bioenergetike in celičnega metabolizma. 16. Molekularni motorji. 17. Protitelesa in imunski odgovor. 18. Biokemija čutil.	8. Enzymes – reactions, kinetics, inhibition, coenzymes. 9. Carbohydrates – structure and biological function. 10. Lipids, biomembranes and membrane transport. 11. DNA and RNA – structure and function. **Molecular basis of cellular processes** 12. Transmission of biological information. 13. Recombinant DNA and biotechnology. 14. Cell cycle and cell death. Oxidative stress. Cancer. 15. Bioenergetics and cellular metabolism. 16. Molecular motors. 17. Antibodies and the immune response. 18. Biochemistry of sensory organs.

Temeljna literatura in viri / Readings:

- Rodney Boyer: Temelji biokemije (Študentska založba, 2005): izbrana poglavja v skupnem obsegu 260 strani.
Za biološka poglavja načrtujemo pripravo spletnih vsebin ali skript v obsegu približno 60 strani.

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Študenti bodo razumeli tiste biološke osnove, ki jim omogočajo razumevanje delovanja molekul v celici in na živo celico ter osnove fizioloških procesov. Razumeli bodo tudi najosnovnejše filogenetske odnose med organizmi in interakcije z okoljem. Zgradbo bioloških makromolekul bodo študenti poznali dovolj natančno, da bodo razumeli metabolične poti in molekularno-biološke procese pri predavanjih, ki nadgrajujejo znanja tega predmeta (npr. pri predmetu Biološka kemija v programu Kemija). Dobro bodo razumeli tudi bioenergetske in metabolične osnove delovanja organizma ter temeljne procese prenosa genetskih informacij. Ob nekaterih zanimivih primerih biokemijskih procesov in tipov bioloških makromolekul bodo bolje razumeli delovanje živega sveta. **Kompetence:** Predmet temelji na povezovanju teoretičnih osnov z laboratorijskim in seminarskim seznanjanjem predvsem z lastnostmi in primeri funkcije makromolekul.	**Objectives:** Students will understand basic biological principles required to follow molecular mechanisms in cells, as well as the fundamentals of physiological processes. They will recognize basic phylogenetic relations among organisms and their interactions with the environment. By knowing the structure of biological macro-molecules students will understand metabolic pathways and molecular biology processes in advanced courses (e.g. Biological Chemistry). Students will also obtain knowledge of the basics of cellular bioenergetics and metabolism as well as the transmission of genetic information. Several interesting examples of biochemical processes will be introdued to provide students with a better understanding of the functional characteristics of living organisms. **Competences:** Theoretical topics will be intertwined with laboratory and seminar work to highlight the properties and examples of macromolecular function. During practical course the precision of laboratory

Študenti se bodo pri vajah urili v natančnosti laboratorijskih meritev in pri iskanju možnih vzrokov za odstopanja od pričakovanih rezultatov. Ob pisanju laboratorijskega dnevnika se bodo naučili pisnega posredovanja meritev in interpretacije rezultatov.	measurements will be trained and discussed. By writing a laboratory logbook, students will learn how to report experimental results and interpret them.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Znanje: osnovno poznavanje zgradbe in delovanja celice in organizma, filogenetskih odnosov med organizmi. Lastnosti bioloških makromolekul ter njihova biološka vloga. Energetske molekule in njihove pretvorbe. Razumevanje: razlike med evkarionti, prokarionti in arhejami, osnovne evolucijske poti, interakcije organizma z okoljem, Delovanje encimov in inhibitorjev, pomen kinetičnih konstant. Osnove skladnosti metaboličnih procesov v celici in organizmu. Princip ohranjanja in prenosa genetske informacije. Celično rojstvo in smrt.	<u>Knowledge and Comprehension</u> Knowledge: basic knowledge of the structure and function of cells and organisms and the phylogenetic relationships between organisms. Properties of biological macromolecules and their biological functions. High-energy molecules and the conversion. Comprehension: difference between eukaryotes, prokaryotes and archaea, basic evolutionary pathways, interaction of organisms with their environment, function of enzymes and their inhibitors, the meaning of kinetic constants. Basic principles of metabolism in the cell and in the organism. Principles of storage and transmission of biological information. Cell birth and death.
<u>Uporaba</u> Občutek za dimenzije v biokemiji in molekularni biologiji. Sposobnost razlikovanja med tipi celic in organizmov. Stopnje v izolaciji makromolekul iz bioloških vzorcev in nekatere ključne metode (liziranje celic, določanje vsebnosti makromolekul, elektroforezna analiza). Povezava eksperimentalnih podatkov s teoretičnimi osnovami procesov. Praktična uporaba metod, ki so vključene v zaključne procese biotehnoloških postopkov.	<u>Application</u> An understanding of dimensions used in biochemistry and molecular biology. The ability to differentiate between different types of cells and organisms. Basic methods for the purification of macromolecules from biological samples (cell lysis, macromolecular content determination, electrophoretic analysis). Linking experimental data with theoretical principles. Practical application of methods involved in final steps of biotechnological processes.
<u>Refleksija</u> Usklajenost delovanja biokemijskih procesov v celici in organizmu. Mutacije kot gonilo razvoja – primerjava z genskim spreminjanjem in vitro. Kinetika encimskih reakcij – primerjava z drugimi kemijskimi reakcijami. Celična smrt kot kontroliran proces. Eksperiment kot osnova za preverjanje hipotez.	<u>Analysis</u> Equilibrium of biochemical processes in the cell and in the organism. Mutations as the driving force of evolution – comparison with genetic alteration in vitro. Kinetics of enzyme-catalysed reactions – comparison with other chemical reactions. Cell death as a regulated process. Experiment as the basic tool for proof of hypothesis.

Prenosljive spretnosti	Skill-transference Ability
Pisanje poročil z vaj, samostojno in skupinsko delo za pripravo seminarjev in kratko poročanje pred občinstvom. Delo s spletnimi študijskimi viri.	Writing reports, individual and team work in the preparation of seminars, short presentation in front of an audience. Work with online study sources.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, laboratorijske vaje, individualno in skupinsko delo pri pripravi seminarjev. Spletna gradiva za določena poglavja.	Lectures, practical laboratory course, individual and team seminar work. Online resources for selected chapters.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- pisni izpit - seminarska naloga - kolokvij iz laboratorijskih vaj		- written exam - seminar - test

Reference nosilca / Lecturer's references:

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

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ORGANSKA ANALIZA
Course Title:	ORGANIC ANALYSIS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**5.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE132

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

Nosilec predmeta / Lecturer: prof. dr. Janez Košmrlj / Dr. Janez Košmrlj, Full Professor

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

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

Vsebina:	**Content (Syllabus outline):**
A) SEPARACIJSKE METODE 1. Ločba zmesi na osnovi razlike v fizikalnih lastnostih: tališče, vrelišče, topnost (voda, raztopine kislin, raztopine baz, organska topila). 2. Kromatografske metode: teoretske osnove, vrste kromatografskih metod, uporaba v analizi organskih spojin, uporaba za preparativne namene, ločba zmesi, uporaba za ločbo enantiomerov. B) IDENTIFIKACIJA ORGANSKIH SPOJIN 1. Kvalitativna in kvantitativna analiza. 2. Določevanje funkcionalnih skupin in priprava derivatov. C) VAJE	A) Separation techniques. 1. Separation of organic compounds on the basis of different physical properties: distillation, solubility (water, organic solvents, acid-base extraction). 2. Chromatographic techniques. Theoretical background, types of chromatographic methods (thin-layer-, column-, gas-chromatography), application in qualitative, quantitative, and preparative organic analyses, separation of mixtures, chiral separation. B) Identification of organic compounds. 1. Qualitative and quantitative analysis. 2. Analysis of functional groups and their derivatives. C) Organic analysis laboratory course is based on individual analysis of a complex organic sample; separation,

Vaje so v obliki individualnega reševanja kompleksnega vzorca; separacija, čiščenje ter identifikacija na osnovi kemijskih metod.	purification, and identification (based on chemical methods).

Temeljna literatura in viri / Readings:

- Shiner, R. L., C. K. F.; Morrill, T. C.; Curtin, D. Y.; Fuson, R. C. The Systematic Identification of Organic Compounds, 8th Edition, J. Wiley & Sons, 2003, 736 strani (30%)

Cilji in kompetence:	**Objectives and Competences:**
Cilji predmeta: Organska analiza se tesno navezuje na predmeta Organska kemija I in II ter Praktikum iz organske kemije. Študent spozna klasične in moderne pristope k analizi zmesi organskih spojin. **Predmetno specifične kompetence**: - priprava in izvedba enostavnih in nekaterih zahtevnejših eksperimentalnih tehnik za ločevanje organskih spojin; - izvajanje standardnih laboratorijskih tehnik za izolacijo in čiščenje organskih spojin; - poznavanje osnov analitike in karakterizacije organskih spojin na osnovi značilnih reakcij na funkcionalne skupine.	The subject is closely related to Organic Chemistry I, Organic Chamistry II and Practicum form Organic Chemistry. Student acquires understanding the principles of qualitative and quantitative organic analysis of mixtures and pure compounds. Ability to design and perform standard and some advanced experimental techniques for separation, isolation and purification of organic compounds. Analysis and characterization of organic compounds based on typical reactions at functional groups.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Pozna osnovne kriterije za ločevanje zmesi organskih spojin.	Knowledge and Comprehension Student learns about criteria for separation of mixtures of organic compounds.
Uporaba Zna uporabiti teoretično znanje za kvalitativno in kvantitativno analizo	Application Student learns how to use theoretical knowledge for qualitative and quantitative organic analysis.
Refleksija Kritično vrednotenje rezultatov pri vajah na osnovi teoretičnega znanja.	Analysis Student critically evaluates and compares the results from practical course with theory.
Prenosljive spretnosti Študent pridobi laboratorijske spretnosti in zna eksperimentalne podatke ustrezno obdelati in primerno interpretirati. Uporaba že pridobljenega znanja iz organske kemije in analizne kemije.	Skill-transference Ability Student acquires laboratory skills and learns how to evaluate and interpret the results from laboratory work also in connection to the organic chemistry courses.

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

Predavanja, seminar in laboratorijske vaje.	Lectures, seminars, practical course.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit od 6 – 10 (pozitivna), od 1 – 5 (negativna)		Written exam.

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.
- J. Košmrlj, S. Kafka, I. Leban, M. Grad: Formation and Structure Elucidation of Two Novel Spiro[2*H*-indol]-3(1*H*)-ones, *Magn. Reson. Chem.* **2007**, *45*, 700–704.
- 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.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ORGANSKA KEMIJA I
Course Title:	ORGANIC CHEMISTRY I

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**3.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**3rd**

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	KE114

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

Nosilec predmeta / Lecturer:	prof. dr. Jurij Svete / Dr. Jurij Svete, Full Professor
Jeziki / Languages:	**Predavanja / Lectures:** **slovenski / Slovenian** **Vaje / Tutorial:** **/**

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

Vsebina:	**Content (Syllabus outline):**
Uvod v organsko kemijo **Struktura in nomenklatura organskih spojin.** **Strukturne značilnosti organskih spojin.** Struktura in vezi v organski kemiji; risanje struktur; atomske in molekularne orbitale, ; ionske in kovalentne vezi; druge povezave; vezi C-C, C-H, C-heteroatom; druge vezi ogljik-ogljik; funkcionalne skupine. **Alkani:** Izomerija; ravne in razvejane verige, strukturne in fizikalne lastnosti, rotacijska izomerija, konformacije idr.. **Cikloalkani:** napetost obročev in struktura, opis strukture; mono-, di- in poli-substituirani cikloheksani in večji obroči, dekalin, heterociklični analogi.	**Introduction to organic chemistry** **Structure and nomenclature of organic compounds.** **Structural properties of organic compounds.** Structure and bonding in organic molecules; drawing structures; atomic and molecular orbitals, ionic and covalent bonds: other bondings; C-C, C-H, C-heteroatom bonds; other bonds carbon-carbon; functional groups. **Alkanes:** Isomerism; straight-chain and branched alkanes, structural and physical properties, rotational isomerism, conformations, etc.. **Cycloalkanes:** ring-strain and the structure of

Alkeni: struktura, π-vez, fizikalne lastnosti, stopnja nenasičenosti, relativna stabilnost dvojne vezi, *cis-trans* in *Z, E*-izomerija. **Alkini:** struktura, lastnosti. **Delokalizirani π-sistemi in aromatske spojine:** struktura; konjugacija, resonanca in resonančna energija; alilni sistem; Hücklovo pravilo in aromatičnost; policiklični sistemi; kondenzirani sistemi; heterociklični analogi; toplota hidrogeniranja in sežigna toplota. **Osnove stereokemije:** kiralne in asimetrične molekule, optična aktivnost, absolutna konfiguracija, projekcijske formule, enantiomere, diastereo(izo)mere, ločba enantiomerov; opis stereokemije. **Reakcijski mehanizmi in intermediati.** Osnove kinetike in termodinamike organskih reakcij. Reakcijski intermediati (karbokationi, karbanioni, radikali, karbeni). Kislost in bazičnost organskih spojin; pKa; nukleofilnost in elektrofilnost. Induktivni in resonančni efekt različnih skupin. Osnove vpliva topil na reakcije in ravnotežja.	cycloalkanes, structure description, mono-, di-, and poly-substituted cyclohexanes, larger cycloalkanes, decalin, heterocyclic analogues. **Alkenes:** structure, π-bond, physical properties, degree of unsaturation, relative stability of the double bond, *cis-trans*- and *Z, E*-isomerism. **Alkynes:** structure, properties. **Delocalized π-systems and aromatic compounds:** structure, conjugation and resonance energy, allylic system; Hückel´s rule and aromaticity, polycyclic systems; condensed systems, heterocyclic analogues; heat of hydrogenation and heat of combustion. **Basic stereochemistry:** chiral and asymmetric molecules, optical activity, absolute configuration, projection formulas, enantiomers, diastereo(iso)mers, separation of enantiomers; description of stereochemistry. **Reaction mechanisms and intermediates.** Basic principles of kinetic and thermodynamic. Reaction intermediates (carbocations, carbanions, carbenes). Acidity and basicity; pKa; nucleophilicity and electrophilicity. Inductive and resonance effect of different groups. Fundamentals of solvent effect on reactions and equilibrium.

Temeljna literatura in viri / Readings:

- K. P. C. Vollhardt, N. E. Schore: Organic Chemistry, W. H. Freeman & Co., 8th Edition, New York, 2018, pp. 1335. (izbrana poglavja, 30 %)

Cilji in kompetence:	**Objectives and Competences:**
Cilj: usvojiti temeljno in celostno znanje organske kemije. Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc: -poznavanje posameznih vrst organskih spojin -poznavanje strukturnih značilnostih organskih spojin -poznavanje reaktivnosti organskih spojin -poznavanje tipičnih organskih reakcij -poznavanje funkcionalnih skupin in njihovih pretvorb	***Objective:*** Understanding the basic principles of organic chemistry. ***General and specific Competences:*** - Knowledge about various types of organic compounds - Structural properties of organic compounds - Reactivity of organic compounds - Typical organic reactions - Functional groups and their

-poznavanje osnov organske stereokemije -poznavanje nomenklature organskih spojin -poznavanje reakcijskih mehanizmov in intermediatov -poznavanje osnovnih principov organske sinteze	transformations - Principles of basic organic stereochemistry - Nomenclature of organic compounds - Reaction mechanisms and reaction intermediates - Basic principles of organic synthesis

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent pozna: - organske spojine glede na strukturo osnovnega skeleta - tipične funkcionalne skupine v organskih spojinah - tipične pretvorbe glavnih funkcionalnih skupin - izomerijo organskih spojin - osnovne pretvorbe organskih spojin - nomenklaturo organskih spojin - značilne reagente, ki se uporabljajo pri osnovnih organskih reakcijah. - osnovne tipe naravnih organskih spojin - osnovne tipe sintetskih organskih materialov Študent razume in zna uporabiti pri samostojnem reševanju problemov: - strukturno raznolikost in izomerijo organskih spojin - osnove organske stereokemije - reaktivnost organskih spojin v povezavi z njihovo strukturo - selektivnost pretvorb - mehanizme osnovnih organskih reakcij - nomenklaturo organskih spojin - kemijsko vlogo organskih spojin ki nastopajo v bioloških sistemih.	Knowledge and Comprehension Student recognizes: - Organic compounds from the structure of the basic skeleton - Typical functional groups in organic compounds - Typical transformation of main functional groups - Isomerism of organic compounds - Basic functional group transformations - Nomenclature of organic compounds - Typical reagents for some basic functional group transformation - Basic types of organic compounds - Basic types of natural organic products - Basic types of synthetic organic materials. Student understands and is capable to apply in solving problems: - Structural versatility and isomerism of organic compounds - Basic principles of organic chemistry - Reactivity of organic compounds based on their structure - Selectivity of organic transformations - Mechanisms of basic organic reactions - Nomenclature of organic compounds - The role of organic compounds in biological systems.

Uporaba Znanje organske kemije je temeljno znanje, ki je osnova za (nadaljnji) študij kemije in se hkrati navezuje na veliko večino ostalih predmetov študija kemije. Poleg tega je temeljno znanje organske kemije nujno potrebno vsakemu kemiku pri njegovem kasnejšem delu v praksi.	Application Organic chemistry knowledge is a basic knowledge in chemistry studies and is connected to many other courses of chemistry programme. Beside this, basic knowledge of organic chemistry is also prerequisite to every chemist at his further practical work.
Refleksija Znanje organske kemije sodi med temeljna kemijska znanja in je temeljni pogoj za delo na vseh ostalih področjih kemije. Predmet je tudi osnova za biokemijo in predmete izbirnega sklopa organske kemije. Študent je pri kasnejšem praktičnem delu sposoben samostojno poiskati relevantne literaturne vire, sintetizirati, izolirati, očistiti in okarakterizirati organske spojine ter kritično ovrednotiti rezultate glede na skladnost s teoretičnimi načeli. Študent je sposoben na podlagi strukture organske spojine sklepati o njenih lastnostih in reaktivnosti (in obratno).	Analysis Organic chemistry knowledge is belonging to the basic knowledge of chemistry that serves as a fundamental expertise for the application on all other areas of chemistry including biochemistry and elective courses of organic chemistry. At his later practical work, student is skilled to find relevant literature sources or to synthesize, isolate, refine and characterize organic compounds as well as critically evaluate results thus obtained. Student is also able to predict structure-property or structure-reactivity relationship.
Prenosljive spretnosti -Poznavanje organske kemije kot temeljno znanje za specifična področja kemije -Uporaba organskih sinteznih in izolacijskih laboratorijskih tehnik na ostalih področjih kemije -Iskanje po klasičnih in elektronskih literaturnih virih in njihova uporaba pri praktičnem delu.	Skill-transference Ability - Organic chemistry as a base for other specific areas of chemistry - The application of organic synthetic and isolation laboratory techniques in other fields of chemistry - Conventional and modern literature sources and their application at the practical work.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja; seminarji, individualni in skupinski projekti.	Lectures, seminars , ; individual and group projects

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni (nadomestita ga lahko dva pozitivno ocenjena kolokvija) in ustni		Written (or two positive test instead) and oral examination.

izpit. Ocene: 6-10 pozitivno		

Reference nosilca / Lecturer's references:

1. ŠENICA, Luka, STOPAR, Karmen, FRIEDRICH, Miha, GROŠELJ, Uroš, PLAVEC, Janez, POČKAJ, Marta, PODLIPNIK, Črtomir, ŠTEFANE, Bogdan, **SVETE, Jurij**. Synthesis and rotational isomerism of 1-substituted methyl (S)-[5-(2- nitrophenyl)-1H-pyrazole-4-carbonyl]alaninates. Journal of organic chemistry, ISSN 0022-3263, 2016, vol. 81, iss. 1, str. 146-161, ilustr. http://pubs.acs.org/doi/abs/10.1021/acs.joc.5b02467, doi: 10.1021/acs.joc.5b02467. [COBISS.SI-ID 1536696771]

2. LOMBAR, Klara, GROŠELJ, Uroš, DAHMANN, Georg, STANOVNIK, Branko, **SVETE, Jurij**. Synthesis of 6-alkyl-7-oxo-4,5,6,7-tetrahydropyrazolo[1, 5-c]pyrimidine-3-carboxamides. Synthesis, ISSN 0039-7881, 2015, vol. 47, iss. 4, str. 497-506, ilustr. https://www.thieme-connect.com/products/ejournals/abstract/10.1055/s-0034-1379547, doi: 10.1055/s-0034-1379547. [COBISS.SI-ID 1536061635]

3. NOVAK, Ana, TESTEN, Ana, BEZENŠEK, Jure, GROŠELJ, Uroš, HRAST, Martina, KASUNIČ, Marta, GOBEC, Stanislav, STANOVNIK, Branko, **SVETE, Jurij**. Synthesis of pyrazolo[1,2-a]pyrazole-based peptide mimetics. Tetrahedron, ISSN 0040-4020. [Print ed.], aug. 2013, vol. 69, no. 32, str. 6648-6665, ilustr., doi: 10.1016/j.tet.2013.05.122. [COBISS.SI-ID 36732421]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ORGANSKA KEMIJA II
Course Title:	ORGANIC CHEMISTRY II

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**4.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	KE121

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

Nosilec predmeta / Lecturer:	prof. dr. Jurij Svete / Dr. Jurij Svete, Full Professor
Jeziki / Languages:	**Predavanja / Lectures:** **slovenski / Slovenian**
	Vaje / Tutorial: **/**

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

Vsebina:	**Content (Syllabus outline):**
Reaktivnost organskih spojin. **Radikalske reakcije.** Radikalske substitucije pri alkanih (halogeniranja). **Nukleofilne substitucije in eliminacije na nasičenih ogljikovih atomih. Lastnosti in reakcije haloalkanov. Bimolekularne nukleofilne substitucije:** nomenklatura, nukleofilne substitucije, vpliv strukture, nukleofilnost in vpliv nukleofilov, izstopajoče skupine, stereokemija S_N2 substitucij, sodelovanje sosednjih skupin, vpliv topila. Sintezno najpomembnejše nukleofilne substitucije. **Unimolekularne substitucije:** Solvoliza terciarnih in sekundarnih haloalkanov, stereokemične posledice S_N1 reakcij, vpliv	**Reactivity of organic compounds.** **Radical reactions.** Radical substitutions on alkanes (halogenations). **Nucleophilic substitutions and eliminations at saturated carbon atoms. Properties and reactions of haloalkanes. Bimolecular nucleophilic substitutions:** nomenclature, nucleophilic substitution, structural effects, nucleophilicity and effect of nucleophiles, leaving groups, stereochemistry of S_N2 substitutions, neighbouring group participation, solvent effect. Synthetically most important nucleophilic substitutions. **Unimolecular substitutions:** solvolysis of tertiary and secondary haloalkanes, stereochemical consequences of S_N1 reactions,

topil, izstopajoče skupine.
Unimolekularne eliminacije E1 and **bimolekularne eliminacije** E2. Sinteza alkenov.
Hidroksi skupina: alkoholi, strukturne in fizikalne lastnosti alkoholov, sinteze z nukleofilno substitucijo, z redoks reakcijo, z organokovinskimi reagenti. Alkoksidi, substitucije in eliminacije, premestitve karbokationov, sinteze in reakcije etrov, žveplovi analogi.
Reakcije alkenov. Radikalske adicije in polimerizacije; katalitsko hidrogeniranje; elektrofilne adicije vodikovih halogenidov in halogenov na alkene; oksimerkuriranje; hidroboriranje; oksidacija s peroksikarboksilnimi kislinami. Markovnikovo in anti-Markovnikovo pravilo.
Alkini. Priprava alkinov z dvojno eliminacijo; alkiliranje alkinil anionov. Elektrofilne adicije na alkine, redukcije alkinov.
Delokalizirani π-sistemi. Nukleofilne substitucije alil halidov, reakcije konjugiranih dienov.
Aromatske spojine. Elektrofilne aromatske substitucije: halogeniranje, nitriranje, sulfoniranje, Friedel-Craftsovo alkiliranje in aciliranje, itd.
Elektrofilne substitucije pri substituiranih aromatih. Aktivacijski in deaktivacijski vpliv skupin pri substituiranih aromatih; elektrofilne substitucije pri disubstituiranih benzenovih derivatih. Primerjava z heteroaromatskimi spojinami.
Sinteza alkilbenzenov; fenoli in amino substituirani benzeni. nitroziranje in arendiazonijeve soli, reakcije pripajanja in druge reakcije.
Nukleofilne aromatske substitucije.
Karbonilne spojine. Sinteza, struktura in reaktivnost karbonilnih spojin. Tavtomerija. Keto-enol tavtomerija; druge tavtomerije.
Aldehidi and ketoni. Adicije nukleofilov, adicija organokovinskih reagentov (Grignardovih reagentov). Adicija na konjugirane karbonilne spojine.
Karboksilne kisline in derivati. Sinteza, struktura, lastnosti in reaktivnost.

solvent effect, leaving groups.
Unimolecular eliminations E1, **bimolecular eliminations** E2. Synthesis of alkenes.
Hydroxy group: alcohols, structural and physical properties of alcohols, syntheses by nucleophilic substitution, by redox reaction, synthesis with organometallic reagents. Alcoxides, substitutions and eliminations, rearrangements of carbocations, syntheses and reactions of ethers, sulphur analogues.
Reactions of alkenes. Radical additions and polymerizations; catalytic hydrogenation; electrophilic additions of hydrogen halides and halogens on alkenes; oxymercuration, hydroboration, oxidation with peroxycarboxylic acids. Markovnikov and anti-Markovnikov rule.
Alkynes. Preparation of alkynes by double elimination; alkylation of alkynyl anions. electrophilic additions on alkynes, reductions of alkynes.
Delocalized π-systems. Nucleophilic substitution of allylic halides, reactions of conjugated dienes.
Aromatic Compounds. Electrophilic aromatic substitutions: halogenations, nitration, sulfonation, Friedel-Crafts alkylation and acylation, etc.
Electrophilic aromatic substitutions on substituted aromatic compounds: activated or deactivated substituted aromatic compounds; electrophilic substitutions at disubstituted benzene derivatives. Comparison with heteroaromatic compounds.Synthesis of alkylbenzene derivatives; phenols and amino-substituted benzene derivatives. nitrosation and arenediazonium salts, coupling reactions and other transformations.
Nucleophilic aromatic substitutions.
Carbonyl compounds. Synthesis, structure and reactivity of carbonyl compounds. Tautomerism. Keto-enol tautomerism; tautomerism with other functional groups.
Aldehydes and ketones. Addition reactions with nucleophiles, addition of organometallic reagents (Grignard reagents). Addition to conjugated carbonyls.
Carboxylic acids and derivatives. Synthesis,

Tvorba in reakcije enolatov. Keto-enol ravnotežje, tvorba enolatov, halogeniranje in alkiliranje enolatov. Reakcije enolov s karbonili: aldolna kondenzacija in sorodne reakcije.	structure, properties and reactivity. **Formation and reactions of enolates.** Keto-enol equilibrium, formation of enolates and their halogenation and alkylation. Reactions of enolates with carbonyls: aldol condensation and related reactions.

Temeljna literatura in viri / Readings:

- K. P. C. Vollhardt, N. E. Schore: Organic Chemistry, W. H. Freeman & Co., 8th Edition, New York, 2018, pp. 1335. (izbrana poglavja, 30 %)

Cilji in kompetence:	**Objectives and Competences:**
Cilj: usvojiti temeljno in celostno znanje organske kemije. Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc: -poznavanje posameznih vrst organskih spojin -poznavanje strukturnih značilnostih organskih spojin -poznavanje reaktivnosti organskih spojin -poznavanje tipičnih organskih reakcij -poznavanje funkcionalnih skupin in njihovih pretvorb -poznavanje osnov organske stereokemije -poznavanje nomenklature organskih spojin -poznavanje reakcijskih mehanizmov in intermediatov -poznavanje osnovnih principov organske sinteze -poznavanje dostopanja do literaturnih virov in njihove uporabe.	***Objective:*** Understanding the basic principles of organic chemistry. ***General and specific Competences:*** - Knowledge about various types of organic compounds - Structural properties of organic compounds - Reactivity of organic compounds - Typical organic reactions - Functional groups and their transformations - Principles of basic organic stereochemistry - Nomenclature of organic compounds - Reaction mechanisms and reaction intermediates - Basic principles of organic synthesis - Access and use of the chemical information bases and other literature sources.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pozna: - organske spojine glede na strukturo osnovnega skeleta - tipične funkcionalne skupine v organskih spojinah - tipične pretvorbe glavnih funkcionalnih skupin - izomerijo organskih spojin	<u>Knowledge and Comprehension</u> <u>Knowledge and Comprehension</u> Student recognizes: - Organic compounds from the structure of the basic skeleton - Typical functional groups in organic compounds - Typical transformations of main functional

- osnovne pretvorbe organskih spojin - nomenklaturo organskih spojin - značilne reagente, ki se uporabljajo pri osnovnih organskih reakcijah. - osnovne tipe naravnih organskih spojin - osnovne tipe sintetskih organskih materialov Študent razume: - strukturno raznolikost in izomerijo organskih spojin - osnove organske stereokemije - reaktivnost organskih spojin v povezavi z njihovo strukturo - selektivnost pretvorb - mehanizme osnovnih organskih reakcij - nomenklaturo organskih spojin - kemijsko vlogo organskih spojin ki nastopajo v bioloških sistemih.	groups - Isomerism of organic compounds - Basic functional group transformations - Nomenclature of organic compounds - Typical reagents for main basic functional group transformation - Basic types of organic compounds - Basic types of natural organic products - Basic types of synthetic organic materials. <u>Student understands and is capable to apply in solving problems:</u> - Structural versatility and isomerism of organic compounds - Basic principles of organic stereochemistry - Reactivity of organic compounds depending on their structure - Selectivity of organic transformations - Mechanisms of fundamental organic reactions - Nomenclature of organic compounds - The role of organic compounds in biological systems.
<u>Uporaba</u> Znanje organske kemije je temeljno znanje, ki je osnova za (nadaljnji) študij kemije in se hkrati navezuje na veliko večino ostalih predmetov študija kemije. Poleg tega je temeljno znanje organske kemije nujno potrebno vsakemu kemiku pri njegovem kasnejšem delu v praksi.	<u>Application</u> Organic chemistry knowledge is a basic knowledge in chemistry studies and is connected to many other courses of chemistry programme. Beside this, basic knowledge of organic chemistry is also prerequisite to every chemist at his further practical work.
<u>Refleksija</u> Znanje organske kemije sodi med temeljna kemijska znanja in je temeljni pogoj za delo na vseh ostalih področjih kemije. Predmet je tudi osnova za biokemijo in predmete izbirnega sklopa organske kemije. Študent je pri kasnejšem praktičnem delu sposoben samostojno poiskati relevantne literaturne vire, sintetizirati, izolirati, očistiti in okarakterizirati organske spojine ter kritično ovrednotiti rezultate glede na skladnost s teoretičnimi načeli.	<u>Analysis</u> Organic chemistry knowledge is belonging to the basic knowledge of chemistry that serves as a fundamental expertise for the application on all other areas of chemistry including biochemistry and elective courses of organic chemistry. At his later practical work, student is skilled to find relevant literature sources or to synthesize, isolate, refine and characterize organic compounds as well as critically evaluate results

Študent je sposoben na podlagi strukture organske spojine sklepati o njenih lastnostih in reaktivnosti (in obratno).	thus obtained. Student is also able to predict structure-property or structure-reactivity relationship.
Prenosljive spretnosti - Poznavanje organske kemije kot temeljno znanje za specifična področja kemije - Uporaba organskih sinteznih in izolacijskih laboratorijskih tehnik na ostalih področjih kemije - Dostopanje do klasičnih in elektronskih literaturnih virov in njihova uporaba pri praktičnem delu.	Skill-transference Ability - Organic chemistry as a base for other specific areas of chemistry - The application of organic synthetic and isolation laboratory techniques in other fields of chemistry - Conventional and modern literature sources and their application at the practical work.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja; seminarji, individualni in skupinski projekti	Lectures, seminars, individual and group projects

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni (nadomestita ga lahko dva pozitivno ocenjena kolokvija) in ustni izpit. Ocene: 6-10 pozitivno		Written (or two positive tests instead) and oral examination.

Reference nosilca / Lecturer's references:

1. ŠENICA, Luka, STOPAR, Karmen, FRIEDRICH, Miha, GROŠELJ, Uroš, PLAVEC, Janez, POČKAJ, Marta, PODLIPNIK, Črtomir, ŠTEFANE, Bogdan, **SVETE, Jurij**. Synthesis and rotational isomerism of 1-substituted methyl (S)-[5-(2- nitrophenyl)-1H-pyrazole-4-carbonyl]alaninates. Journal of organic chemistry, ISSN 0022-3263, 2016, vol. 81, iss. 1, str. 146-161, ilustr. http://pubs.acs.org/doi/abs/10.1021/acs.joc.5b02467, doi: 10.1021/acs.joc.5b02467. [COBISS.SI-ID 1536696771]
2. LOMBAR, Klara, GROŠELJ, Uroš, DAHMANN, Georg, STANOVNIK, Branko, **SVETE, Jurij**. Synthesis of 6-alkyl-7-oxo-4,5,6,7-tetrahydropyrazolo[1, 5-c]pyrimidine-3-carboxamides. Synthesis, ISSN 0039-7881, 2015, vol. 47, iss. 4, str. 497-506, ilustr. https://www.thieme-connect.com/products/ejournals/abstract/10.1055/s-0034-1379547, doi: 10.1055/s-0034-1379547. [COBISS.SI-ID 1536061635]
3. NOVAK, Ana, TESTEN, Ana, BEZENŠEK, Jure, GROŠELJ, Uroš, HRAST, Martina, KASUNIČ, Marta, GOBEC, Stanislav, STANOVNIK, Branko, **SVETE, Jurij**. Synthesis of pyrazolo[1,2-a]pyrazole-based peptide mimetics. Tetrahedron, ISSN 0040-4020. [Print ed.], aug. 2013, vol. 69, no. 32, str. 6648-6665, ilustr., doi: 10.1016/j.tet.2013.05.122. [COBISS.SI-ID 36732421].

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ORGANSKA KEMIJA III
Course Title:	ORGANIC CHEMISTRY III

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**5.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE131

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

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

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Pretvorbe π-sistemov: periciklične reakcije. Cikloadicije, elektrociklizacije, sigmatropne premestitve. **Molekulske premestitve.** Premestitve karbokationov in karboanionov, premestitve na C=X vezeh. **Oksidacije in redukcije organskih spojin.** Klasifikacija organskih spojin po oksidacijskem nivoju. Značilne metode za oksidacijo in redukcijo ogljikovega skeleta in funkcionalnih skupin. **Heterociklične spojine**: nomenklatura, lastnosti, osnovni sintezni principi, tipična reaktivnost, primeri pomembnih heterocikličnih spojin.	**Transformations of π-systems: pericyclic reactions.** Cycloadditions, electrocyclisations, sigmatropic rearrangements. **Molecular rearrangements.** Rearrangements of carbocations and carboanions, rearrangements on C=X bonds. **Oxidations and reductions of organic compounds.** Classification of organic compounds by oxidation level. Typical methods for oxidation and reduction of carbon framework and functional groups. **Heterocyclic compounds:** nomenclature, properties, basic synthetic principles, typical reactivity, examples of important heterocycles. **Carbohydrates:** structure of monosaccharides,

Ogljikovi hidrati: struktura monosaharidov, sinteze, pretvorbe, disaharidi in polisaharidi. **Nukleinske kisline.** **Amino kisline, peptidi in beljakovine**: sinteze amino kislin, reaktivnost in nastanek peptidov, struktura peptidov in beljakovin. **Organska barvila**. Naravna in sintezna barvila. **Sintezne makromolekule in organski materiali.** Osnovni tipi sinteznih polimerov, njihova sinteza in lastnosti. Značilni organski materiali.	syntheses, transformations, disaccharides and polysaccharides. **Nucleic acids.** **Amino acids, peptides and proteins:** synthesis of amino acids, reactivity, formation of peptides, structure of peptides and proteins **Organic dyes.** Natural and synthetic dyes. **Synthetic macromolecules and organic materials.** Types of synthetic polymers, their synthesis and properties. Characteristic organic materials.

Temeljna literatura in viri / Readings:

- K. P. C. Vollhardt, N. E. Schore: Organic Chemistry, W. H. Freeman & Co.5th Edition, New York, 2007. (Ustrezna poglavja 30%)

Cilji in kompetence:	**Objectives and Competences:**
Cilj**:** usvojiti temeljno in celostno znanje organske kemije. Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc: -poznavanje posameznih vrst organskih spojin -poznavanje strukturnih značilnostih organskih spojin -poznavanje reaktivnosti organskih spojin -poznavanje tipičnih organskih reakcij -poznavanje funkcionalnih skupin in njihovih pretvorb -poznavanje osnov organske stereokemije -poznavanje nomenklature organskih spojin -poznavanje reakcijskih mehanizmov in intermediatov -poznavanje osnovnih principov organske sinteze -poznavanje dostopanja do literaturnih virov in njihove uporabe	Objectives: To obtain basic and comprehensive knowledge of organic chemistry. Competences: Knowledge about: - classes and types of organic compounds, - structural properties of organic compounds, - reactivity of organic compounds, - typical organic reactions, - functional groups and their transformations, - basic organic stereochemistry, - nomenclature of organic compounds, - reaction mechanism and reaction intermediates, - basic principles of organic synthesis, - accessing to and the use of literature sources.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pozna: - organske spojine glede na strukturo osnovnega skeleta - tipične funkcionalne skupine v organskih spojinah - tipične pretvorbe glavnih funkcionalnih skupin - izomerijo organskih spojin	<u>Knowledge and Comprehension</u> The student knows: - classes and types of organic compounds with respect to their structure, - typical functional groups in organic compounds - typical transformations of organic functional groups - isomerism of organic compounds,

- osnovne pretvorbe organskih spojin - nomenklaturo organskih spojin - značilne reagente, ki se uporabljajo pri osnovnih organskih reakcijah. - osnovne tipe naravnih organskih spojin - osnovne tipe sintetskih organskih materialov Študent razume: - strukturno raznolikost in izomerijo organskih spojin - osnove organske stereokemije - reaktivnost organskih spojin v povezavi z njihovo strukturo - selektivnost pretvorb pret - mehanizme osnovnih organskih reakcij - nomenklaturo organskih spojin - kemijsko vlogo organskih spojin ki nastopajo v bioloških sistemih.	- basic transformations of organic compounds, - nomenclature of organic compounds, - typical reagents used in organic reactions, - basic types of natural organic compounds, - basic types of synthetic organic materials The student understands: - structural diversity and isomerism of organic compounds, - principles of organic stereochemistry, - structure-reactivity relationship in organic compounds, - selectivity of organic transformations, - reaction mechanism and reaction intermediates for fundamental organic reactions, - nomenclature of organic compounds, - chemical role of organic compounds involved in biological systems.
<u>Uporaba</u> Znanje organske kemije je temeljno znanje, ki je osnova za (nadaljnji) študij kemije in se hkrati navezuje na veliko večino ostalih predmetov študija kemije. Poleg tega je temeljno znanje organske kemije nujno potrebno vsakemu kemiku pri njegovem kasnejšem delu v praksi.	<u>Application</u> The knowledge of organic chemistry is the fundamental one. It is the basis for the (continued) study of chemistry. Therefore, it is connected and, hence, applicable to the majority of other subjects within the Chemistry study. Besides, the basic knowledge of organic chemistry is the inevitable prerequisite for any chemist in practical work after study.
<u>Refleksija</u> Znanje organske kemije sodi med temeljna kemijska znanja in je temeljni pogoj za delo na vseh ostalih področjih kemije. Predmet je tudi osnova za biokemijo in predmete izbirnega sklopa organske kemije. Študent je pri kasnejšem praktičnem delu sposoben samostojno poiskati relevantne literaturne vire, sintetizirati, izolirati, očistiti in okarakterizirati organske spojine ter kritično ovrednotiti rezultate glede na skladnost s teoretičnimi načeli. Študent je sposoben na podlagi strukture organske spojine sklepati o njenih lastnostih in reaktivnosti (in obratno).	<u>Analysis</u> Knowledge of organic chemistry is the fundamental knowledge required for practical work in all areas of chemistry. The knowledge of organic chemistry is also a prerequisite for study of biochemistry and elective courses from various specialized topics in organic chemistry. This knowledge enables a student to find the relevant literature sources, to synthesize, to isolate, and to characterize a given organic compound. The student is also able of critical evaluation of the results and their conformity with theoretical principles. On the basis of the structure of a given organic compound, the student is also able to draw conclusions (or to predict) the properties and reactivity of this compound.

Prenosljive spretnosti - Poznavanje organske kemije kot temeljno znanje za specifična področja kemije - Uporaba organskih sinteznih in izolacijskih laboratorijskih tehnik na ostalih področjih kemije - Dostopanje do klasičnih in elektronskih literaturnih virov in njihova uporaba pri praktičnem delu.	Skill-transference Ability - Knowledge about organic chemistry as fundamental knowledge for specific areas of chemistry - The use of synthetic and isolation laboratory techniques on other areas of chemistry - Accessing classical and electronic literature sources and its use in practical work

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

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

Reference nosilca / Lecturer's references:

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

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVE KEMIJSKEGA INŽENIRSTVA
Course Title:	PRINCIPLES OF CHEMICAL ENGINEERING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemisrty, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code:

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

Nosilec predmeta / Lecturer: prof. dr. Matjaž Krajnc / Dr. Matjaž Krajnc, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Osnovni koncepti. Pomen snovne in energijske bilance pri razumevanju, analizi in načrtovanju kemijskih procesov. Koncept kontrolnega volumna. Snovna in energijska bilanca za diferencialni element Procesne sheme. Transportni pojavi. Viskoznost; karakteristike toka tekočin; tok tekočin in prvi zakon termodinamike; laminarni in turbulentni tok: hitrostna porazdelitev in izračun linijskih izgub v cevi; mešanje. Mehanizmi prenosa toplote; stacionarno prevajanje; nestacionarno prevajanje; konvektivni prenos toplote. Mehanizmi prenosa snovi; stacionarna difuzija; nestacionarna difuzija; konvektivni prenos snovi, prenos snovi med fazami. Kemijsko reakcijsko inženirstvo. Kinetika	Basic concepts. Importance of mass and energy balance for the understanding, analysis and design of chemical processes. Concept of the control volume. Differential mass and energy balance of the Process scheme. Transport phenomena. Viscosity; fluid flow characteristics; fluid flow and 1st law of thermodynamics; laminar and turbulent flow: velocity distribution and calculation of linear losses in the pipe flow; mixing. Mechanisms of heat transfer; steady state conductivity; transient conductivity; convective heat transfer. Mechanisms of mass transport; steady state diffusion; transient diffusion; convective mass transfer; interphase mass transfer. Chemical reaction engineering. Kinetics of homogeneous and heterogeneous

homogenih in heterogenih reakcij; hitrost kemijske reakcije; osnove načrtovanja kemijskih reaktorjev. Primeri uporabe temeljnih kemijsko inženirskih znanj. Destilacijske metode; ekstrakcijski procesi; absorpcija; sušenje.	chemical reactions; rate of chemical reaction; fundamentals of chemical reactor design. Applications of fundamental chemical engineering principles. Distillation processes; extraction processes; absorption; drying

Temeljna literatura in viri / Readings:

- S. Simons, E. Sorensen, T. Elson, S. Brandani: Concepts of Chemical Engineering 4 Chemists. The Royal Society of Chemisrty, 2007, 350 str. (60%)

Dodatna literaura / Additional Readings:
T. Koloini: Prenos toplote in snovi, FNT, Ljubljana, 1994,240 str. (60%).
H. S. Fogler: Elements of chemical reaction Engineering, Prentice Hall, Inc., 2006, 1120 str. (30%)

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je študente ob predhodnem poznavanju naravoslovnih ved seznaniti z osnovnimi koncepti v kemijsko inženirski stroki. Predmetno specifične kompetence: študent je z osvojenimi znanji sposoben - prepoznavanja in ovrednotenja določnega procesa - nastavitve snovnih in energijskih bilanc - izračuna linijskih izgub vodnikov - dimenzioniranja osnovnih aparatov za prenos toplote in prenos snovi - načrtovanja racionalnega eksperimentalnega dela v laboratoriju ali v industriji - pravilnega razumevanja in vrednotenja rezultatov eksperimentalnega dela	Objective of the course is to aquaint student, who already has knowledge of natural sciences, with basic concepts in chemical engineering. Subject specific competences: - Identification and evaluation of a certain process, - To define equations of mass and energy balances - Evaluation of head loses in pipe flow - Dimensioning and design of heat and mas transfer devices - Planning of rational experimental work in laboratory and in industrial plant - Proper understanding and evaluation of results obtained by experimental work

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent bo po osvojitvi pojmov, zakonitosti, teorij in pojavov, ki jih podaja ta predmet, sposoben razumeti specifičnosti kemijsko inženirske stroke ter pomena matematike, fizike, kemije, računalništva in osnovnih	<u>Knowledge and Comprehension</u> Understanding of basic principles of chemical engineering knowledge required in further courses and later, during employment. Ability for basic analysis, synthesis and quality evaluation of plain chemical technology

principov kemijskega inženirstva v kemijski procesni tehniki.	processes.
Uporaba Pridobljena znanja o kemijsko inženirskih zakonitostih in principih je sposoben uporabiti pri reševanju posameznih praktičnih računskih primerov in problemov v kemijski procesni tehniki in v nadaljnjem študiju.	Application Student is able to apply the knowledge of chemical engineering principles in solving specific practical calculation cases in chemical process technology problems. The acquired knowledge is necessary for further study.
Refleksija Študent bo razumel osnovne principe kemijskega inženirstva in razvil veščine za analizo in kritično ovrednotenje tehnološke sheme procesa oziroma posamezne naprave.	Analysis Student understands basic principles of chemical engineering and develops skills for analysis and critical evaluation of technological scheme or specific equipment.
Prenosljive spretnosti Pri predmetu se študent nauči sintetizirati vsebine znanj, pridobljene z različnih področij tehničnih in naravoslovnih segmentov, ter tako pridobi vzorec za inovativno delo na drugih področjih.	Skill-transference Ability By matter of this course student learns to connect knowledge of different technical and natural science segments and aquires mode for innovative work in different fields.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in seminarji.	Lectures and seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit. Ocene: 6-10 pozitivno.		Written and oral exam. Grades: 6-10

Reference nosilca / Lecturer's references:

- ŠINKOVEC, Ervin, POHAR, Andrej, KRAJNC, Matjaž. Phase transfer catalyzed esterification : modeling and experimental studies in a microreactor under parallel flow conditions. *Microfluidics and nanofluidics*, ISSN 1613-4982, 2013, vol. 14, no. 3/4, str. 489-498. [COBISS.SI-ID 36262917]
- LIKOZAR, Blaž, KRAJNC, Matjaž. Cross-linking of polymers : kinetics and transport phenomena. *Industrial & engineering chemistry research*, ISSN 0888-5885. [Print ed.], 2011, vol. 50, no. 3, str. 1558-1570. [COBISS.SI-ID 35022341]
- LIKOZAR, Blaž, KRAJNC, Matjaž. Simulation of chemical kinetics of elastomer crosslinking by organic peroxides. *Polymer engineering and science*, ISSN 0032-3888, 2009, vol. 49, no. 1, str. 60-72. [COBISS.SI-ID 30003205]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVE PROGRAMIRANJA
Course Title:	INTRODUCTION TO PROGRAMMING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemijsko inženirstvo, 1. stopnja, UŠP Biokemija, 1. stopnja, UŠP Kemija, 1. stopnja	**/**	**1./2.**	**1./3.**
USP Chemical Engineering, 1st Cycle, USP Biochemistry, 1st Cycle, USP Chemistry, 1st Cycle	**/**	**1st/2nd**	**1st/3rd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code:

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

Nosilec predmeta / Lecturer: izr. prof. dr. Miha Moškon / Dr. Miha Moškon, Assistant Professor

Jeziki / Languages:

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

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

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

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Študenti bodo v okviru predmeta spoznali:

1. Uvod v računalništvo
   a. Programska oprema
   b. Algoritem
2. Programiranje v Pythonu
   a. Osnove programiranja
   b. Spremenljivke
   c. Osnovni podatkovni tipi
   d. Stavki (priredilni, pogojni, zanke)
   e. Funkcije
   f. Vhod in izhod
   g. Knjižnice

Content (Syllabus outline):

Students in this course will learn:

1. Introduction to computers
   a. Software
   b. Algorithm
2. Programming in Python
   a. Basics of programming
   b. Variables
   c. Basic data types
   d. Sentences (assignment, conditional, loops)
   e. Functions
   f. Input and output

h. Datoteke i. Analiza in vizualizacija podatkov j. Iskanje in popravljanje napak	g. Libraries h. Files (read, write) i. Data analysis and visualization j. 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:**
<u>Znanje in razumevanje</u> Poznavanje programske opreme in uporabe algoritmov. Poznavanje osnovnih programskih konstruktov (spremenljivke, stavki, zanke, funkcije, …) in njihova učinkovita uporaba za reševanje programerskih problemov.	<u>Knowledge and Comprehension</u> Knowledge of software tools and algorithms. Knowledge of basic programming constructs (variables, statements, loops, functions, …) and their efficient use to solve programming problems.
<u>Uporaba</u> 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.	<u>Application</u> 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.
<u>Refleksija</u> Spoznavanje osnov algoritmičnega razmišljanja in kodiranja računalniškega programa.	<u>Analysis</u> Getting to know basic algorithmic thinking and coding of computer program.

Prenosljive spretnosti Poznavanje in uporaba računalniških orodij. Poznavanje in učinkovita uporaba osnovnih konceptov programiranja.	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. Vsi koncepti so predstavljeni na nazoren in sistematski način s številnimi zgledi, poudarek je na njihovi uporabi na praktičnih primerih.	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. 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 (v %) / Weight (in %)	**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	**100 %**	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.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	POVRŠINSKA IN KOLOIDNA KEMIJA
Course Title:	SURFACE AND COLLOID CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI11

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

Nosilec predmeta / Lecturer: prof. dr. Ksenija Kogej / Dr. Ksenija Kogej, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Uvod. Klasifikacija koloidnih sistemov. Osnovni pojmi: površina/medfazna meja. Medfazne površine tekoče/plin, tekoče/tekoče, tekoče/trdno. Laplaceova in Kelvinova enačba. Adsorpcija in orientacija na površinah. Monomolekularni filmi. Adhezija. Kohezija. Kontaktni kot in omočenje. Flotacija. Medfazna površina trdno/plin. Adsorpcijske izoterme. Teorija Brunauer-Emmet-Teller. Površinska kataliza. Asociacijski koloidi. Micelizacija. Kritična micelna koncentracija. Termodinamika nastanka micel. Hidrofobne interakcije. Solubilizacija. Van der Waalsove sile. Enačbe za opis van der Waalsovih interakcij. Lennard-Jonesov potencial. Hamakerjeva konstanta. Nabite površine in električna dvojna plast.	Introduction. Classification of colloidal systems. Basic concepts: surface/interface. Liquid-gas, liquid-liquid, liquid-solid interfaces. The Laplace and Kelvin equation. Adsorption and orientation at interfaces. Monomolecular films. Adhesion, cohesion, contact angle and wetting. Flotation. Soli-gas interface. Brunauer-Emmet-Teller (BET) theory. Surface catalysis. Association colloids. Micelle formation. Critical micelle concentration. Thermodynamics of micelle formation. Hydrophobic interactions. Solubilization. Van der Waals forces: power laws. Lennard-Jones potential. Hamaker constant. Charged surfaces and electric double layer. Gouy-Chapman and Stern model of electric double layer. The zeta potential.

Gouy-Chapmanov in Sternov model električne dvojne plasti. Zeta potencial. Elektrokinetični pojavi. Stabilnost koloidnih sistemov. Teorija Derjaguin-Landau-Verwey-Overbeek (ali DLVO). Elektrostatična in sterična stabilizacija koloidnih sistemov. Kinetika koagulacije. Termodinamika koagulacije in kritična temperatura flokulacije. Emulzije in pene. Reologija disperzij.	Electrokinetic phenomena. Stability of colloid systems. Derjaguin-LandanuVerwey-Overbeek (DLVO) theory. Electrostatic and steric stabilization of colloidal systems. Kinetic of coagulation. Thermodynamics of coagulation and critical coagulation temperature. Emulsions and foams. Rheology of dispersions.

Temeljna literatura in viri / Readings:

Temeljna literatura:

- Duncan J. Shaw: Introduction to Colloid and Surface Chemistry, 4th Edition, Butterworth Heinemann, London, 1992, 168 strani (60 %).
- Ksenija Kogej: Površinska in koloidna kemija (univerzitetni učbenik), 2. izdaja, Ljubljana: Univerza v Ljubljani, Fakulteta za kemijo in kemijsko tehnologijo, 2015, 185 str. ISBN 978-961-6756-56-3 (100 %).

Dopolnilna literatura:

- Paul C. Hiemenz, Raj Rajagopalan: Principles of Colloid and Surface Chemistry, 3rd Edition, Marcel Dekker, New York, 1997, 650 strani.
- D. Fennell Evans, Håkan Wennerström: The Colloidal Domain: Where Physics, Chemistry, Biology, and Technology Meet, 2nd Edition, Wiley-VCH, New York, 1999, 630 strani.
- Bo Jönsson, Björn Lindman, Krister Holmberg, Bengt Kronberg: Surfactants and Polymers in Aqueous Solution, John Wiley & Sons, Chichester, 1998, 438 strani.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je študentu podati znanja, ki mu bodo pomagala pri prepoznavanju in razumevanju pojavov, ki so povezani z medfaznimi površinami. Seznani ga s sistemi, ki vsebujejo delce koloidnih dimenzij, in z zakonitostmi, ki v takih sistemih veljajo. **Kompetence:** S pridobljenim znanjem bo študent sposoben reševati probleme na različnih področjih naravoslovja in tehnologije (od kemije, fizike, biokemije, do ved o poznavanju materialov, farmacije, številnih tehnoloških ved in podobnem), kjer so pomembne interakcije med koloidnimi delci in kjer igrajo pojavi na medfaznih površinah odločilno vlogo.	*Objectives* of the course are to give students the necessary knowledge to recognize and understand phenomena related to surfaces/interfaces. Students get acquainted with systems containing particles of colloidal dimensions and with principles that govern the behavior in colloidal systems. *Competences*: with the acquired knowledge students will be able to solve problems from various fields of natural sciences and technology (e.g. chemistry, physics, biology, material sciences, pharmacy, medicine, and others) where interactions between colloid particles and phenomena at interfaces play an important role.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Pri študiju predmeta bo študent spoznal specifične pojme s področja koloidne kemije.	<u>Knowledge and Comprehension</u> Students will learn about phenomena that are specific for the field of colloid chemistry and will

Razumel bo pojave na medfaznih površinah in vpliv ukrivljenosti površine na lastnosti, ki jih je spoznal že pri fizikalni kemiji (npr. na parni tlak, topnost). Spoznal bo fizikalno-kemijske procese s področja koloidne kemije. Pridobil bo znanje o vrstah sil, ki so pomembne v koloidnih sistemih, kakšen je njihov vpliv na stabilnost sistemov in kako lahko na stabilnost vplivamo. Znanje mu bo omogočalo razumeti dogajanje v realnih koloidnih sistemih in nanj vplivati.	get acquainted with physical processes related to the colloidal domain. After the completion of the course they will understand the effect of curvature on vapor pressure of liquids and on solubility of solids, capillary condensation, etc., they will appreciate forces that are important in colloidal systems and how to affect stability of colloids. The acquired knowledge enables students to understand practical colloidal systems and their manipulation.
<u>Uporaba</u> V času hitro razvijajoče tehnološke družbe se neprestano pojavljajo novi materiali in nove tehnologije, ki vključujejo koloidne materiale. Znanje, ki ga študent pridobi pri študiju površinske in koloidne kemije, je zato za moderno družbo izjemno pomembno. Uporabno ni le v tehnologiji, temveč tudi za globlje razumevanje bioloških procesov ali pa pri razvoju farmacevtskih oblik za dostavo zdravilnih učinkovin na ustrezno mesto delovanja v organizmu. Iz tega sledi, da bo pridobljeno znanje uporabno tako pri razvoju novih materialov kot pri reševanju raznih praktičnih problemov.	<u>Application</u> In the fast developing technological society, new materials and new technologies involving colloids are appearing constantly. The knowledge offered to students through this course is therefore very important. It is not only useful in technological applications but also, e.g., in understanding biological processes or in the development of pharmaceutical formulations used for drug delivery. Students will be able to use the knowledge in the development of new materials and in solving various practical problems.
<u>Refleksija</u> Študent se s pridobljenim teoretičnim znanjem nauči interpretirati praktične probleme. V namen preizkusa lastnega razumevanja snovi študent (ali skupina 2-3 študentov) v obliki seminarja predstavi določen problem iz področja površinske in koloidne kemije, ki ga lahko izbere sam ali ob pomoči predavatelja (na primer iz vsakdanjega življenja ali iz aktualne tuje in domače znanstvene literature). Pri razlagi tematike uporabi pridobljeno teoretično znanje in pokaže, kako sam razume kompleksne koloidne pojave v realnih sistemih.	<u>Analysis</u> The theoretical knowledge acquired in this course enables students to interpret practical problems/observations. To verify their understanding, students (individually or in smaller groups) will present a subject from the field of surface and colloid chemistry in the form of an oral seminar/presentation. The subject can be related either to the research work of their diploma thesis or chosen from everyday life and is selected with the help of the teacher. In their presentation, students use the theoretical knowledge learned during the course and demonstrate the understanding of complex colloidal phenomena in real systems.
<u>Prenosljive spretnosti</u> Poleg znanj iz področja površinske in koloidne kemije bo študent pridobil izkušnje in spretnosti pri iskanju in uporabi raznih literarnih virov (svetovni splet, podatkovne baze, domača in tuja literatura) in didaktičnih	<u>Skill-transference Ability</u> In addition to specific competences related to surface and colloid chemistry, students get experience and skills in literature and data searching in various data bases. They get experience in working in smaller teams and in

pripomočkov (javno ustno poročanje, elektronski didaktični pripomočki, itd.). Pridobil bo izkušnje v delu v skupini, v javnem nastopanju ter poročanju in debatiranju o aktualnih problemih iz svojega strokovnega področja. Razvil bo kritičen način razmišljanja o pojavih v naravoslovju in tehnologiji.	discussing and presenting their results in public. They develop a critical way of thinking about problems in science and technology.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja. Seminarji, ki jih pripravijo študenti v manjših skupinah. Seznanitev študentov z možnostmi raziskovalnega dela s področja površinske in koloidne kemije.	Classes. Student seminars. Individual work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Računski projekt: 30% Seminarska naloga (aktualna tema iz literature): 50% Ustni zagovor: 20%	**30%** **50%** **20%**	

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]

-PAVLI, Matej, BAUMGARTNER, Saša, KOS, Petra, KOGEJ, Ksenija. Doxazosin-carrageenan interactions: a novel approach for studying drug-polymer interactions and relation to controlled drug release. *International journal of pharmaceutics*, ISSN 0378-5173. [Print ed.], 2011, vol. 421, issue 1, str. 110-119, [COBISS.SI-ID 3094897]

-PELJHAN, Sebastijan, ŽAGAR, Ema, CERKOVNIK, Janez, KOGEJ, Ksenija. Strong intermolecular association between short poly(ethacrylic acid) chains in aqueous solutions. *The journal of physical chemistry. B, Condensed matter, materials, surfaces, interfaces & biophysical*, ISSN 1520-6106, 2009, vol. 113, no. 8, str. 2300-2309. [COBISS.SI-ID 22456103]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIČNI PRISTOPI V ANALIZNI KEMIJI
Course Title:	PRACTICAL APPROACHES IN ANALYTICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI7

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

Nosilec predmeta / Lecturer: izr. prof. dr. Nataša Gros / Dr. Nataša Gros, Assoc. Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Koncepti sodobne analizne kemije. Stopnje analiznega postopka; pomen in vpliv posameznih stopenj na rezultate kemijskih analiz. Jemanje in shranjevanje vzorcev, priprava laboratorijskega vzorca. Značilnosti analitike sledov, mikroanaliza značilnosti in zahteve; kontaminacija in slepa vrednost; vplivi slepe vrednosti na analizne parametre; priprava analiznih reagentov. Lastnosti sodobnih laboratorijskih materialov, pogoji za analitiko sledov, čiščenje reagentov in laboratorijske posode. Suhi, mokri sežig, taline, razkroji pri povišanem tlaku, mikrovalovni razkroj.	Concepts of modern analytical chemistry, steps in analytical procedures and their importance for the accuracy and precision of the results. Sampling, storage of samples, preparation of laboratory samples. Trace analysis and micro analysis, problems related with contamination of samples and blank values. The influence of blank values on the parameters of analytical procedure. Preparation of analytical reagents for trace analysis and cleaning of glassware for trace analysis. Sample decomposition; acid dissolution, decomposition by fluxes, wet and dry ashing procedures, pressurized dissolution of samples,

Pregled metod za za predkoncentriranje in separiranje analitov v kompleksnih vzorcih. Izbira analizne metode (kriteriji in strategije). Pregled metod za določevanje kemijskih zvrsti (speciacija), priprava vzorcev za speciacijsko analitiko. Praktični primeri. Validacija analiznih metod in postopkov. Sledljivost rezultatov v kemijski analizi; SI sistem, primerljivost in sledljivost meritev, mednarodni in nacionalni merski etaloni, osnovni dokumenti v meroslovju (VIM), referenčni materiali, medlaboratorijsko preskušanje. Kvaliteta analiznih rezultatov; sistemi kakovosti v analizni kemiji, zagotavljanje kvalitete v analiznem laboratoriju. Model ISO 17025, Model GLP, sistemi akreditacije. Laboratorijske vaje usmerjajo slušatelje v samostojno delo v analiznem laboratoriju ter mu podajo osnove raziskovalnega dela. Nekatere okvirne teme: jemanje vzorcev, koncentriranje v atomski spektrometriji, mikrovalovni razkroji priprava in analiza kompleksnih vzorcev s tehnikami atomske spektroskopije, priprava vzorcev za kromatografsko analizo, validacija metod,...	microwave assisted decomposition. Survey of typical separation procedures, their characteristics and importance for analytical chemistry. Survey of methods for chemical speciacion, samplke preparation for speciation analysis. Validation of analytical method. Traceability in chemical analysis, national and international reference materials, basic documentation in metrology (VIM), proficiency testing. Quality systems and quality assurance in analytical chemistry, ISO 17025 standard, good laboratory practice, accreditation systems. Practical laboratory training is oriented towards gaining skills for solving typical analytical problems. Some examples: preconcentration approaches in atomic absorption spectrometry, microwave assisted decomposition of environmental samples and their analysis by AAS, preparation of samples for chromatographic analysys, validation of methods,...

Temeljna literatura in viri / Readings:

Izbrana poglavja iz različnih učbenikov v skupnam obsegu 200 strani (Skoog, , Harris),
- J. P Dux Handbook of Quality assurance for the Analytical Chemistry Lab (Van Nostrand Reihold),
- Kateman Buydens; Quality Control in Analytical Chemistry (Wiley),
- Dokumenti EURACHEM-a

Selected chapters from fundamental textbooks (Skoog et al, Fundamental of analytical chemistry, Saunders Publishig,; Harris, Analytical Chemistry), J. Dux, Handbook of quality assurance for the analytical Chemistry,Van Nostrand Reinhold, Kateman Buydens, Quality Control in Analytical Chemistry ,Wiley and sons, EURACHEM documents.(http://www.eurachem.org/)

Cilji in kompetence:	**Objectives and Competences:**
Študenti se pri predmetu seznanijo in usposobijo za reševanje praktičnih analiznih problemov ter nalog v analiznih in kontrolnih laboratorijih, s poudarkom na veščinah in postopkih, ki zagotavljajo kvaliteto analiznih rezultatov.	Students will acquire knowledge for solving practical analytical problems in analytical or control laboratory with emphasis on skills which enable quality of analytical results.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študentje naj bi pridobili praktična znanja, ki so potrebna za uspešno delo v analiznih in kontrolnih laboratorijih in so nujna pri odločitvah (kontrola kakovosti!) in so temelj za izvedbo zanesljivih analiz. Prav tako bodo sposobni kritično presoditi zmogljivosti nekaterih analiznih metod, primerjati klasične in instrumentalne pristope v analitiki ter ustrezno obravnavati rezultate kemijskih analiz.	Knowledge and Comprehension Students will gain practical knowledge necessary for work in analytical laboratories and are important for different decisions (quality control) are basis for the performance of reliable analysis. In addition they will be able for critical evaluation of different analytical procedures and to compare classical and instrumental approaches in analytical practice and to evaluate analytical results.
Uporaba Dobljena znanja bodo omogočila uspešno delo v analizni praksi.	Application The obtained knowledge will enable successful work in analytical laboratory.
Refleksija Spozna prednosti in slabosti različnih analiznih postopkov ter pridobi kritični odnos eksperimentalnega dela, ki omogoča ustrezno interpretacijo analiznih rezultatov.	Analysis Student will be informed on advantages and disadvantages of different analytical procedures and will be able for critical approach important for selection of proper analytical procedure for selected problems. And will be able for the relevant interpretation of analytical results.
Prenosljive spretnosti Pri predmetu bo študent pridobil laboratorijske spretnosti za izvedbo zahtevnih analiznih postopkov, eksperimentalne podatke bo znal ustrezno obdelati , primerno interpretirati ter jih kvalitetno pisno podajati.	Skill-transference Ability Students will gain practical skills to perform complex analytical procedures, they will be able to process and present analytical data.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, eksperimentalno delo. Projektno in problemsko usmerjeno delo.	Lectures, experimental work, problem oriented project work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Poročila o laboratorijskem delu	**40**	Reports on laboratory work
Pisni izpit	**60**	Written exam

Reference nosilca / Lecturer's references:

-GROS, Nataša. Microdiffusion-based UV-LED spectrometric setup for determining low levels of ethanol in fruit juice. Talanta, ISSN 0039-9140. [Print ed.], 2011, vol. 87, no. 1, str. 174-179.

-GROS, Nataša, CAMÕES, Maria Filomena, SILVA, Ricardo J. N. Bettencourt da. Detailed

uncertainty budget for major and minor ions in stock combined calibration standards : influence of impurities in chemicals. Analytica chimica acta, ISSN 0003-2670. [Print ed.], 2010, vol. 659, no. 1/2, str. 85-92.

-GROS, Nataša, NEMARNIK, Andrej. Accurately determining hydrogen carbonate in water in the presence of or simultaneously with the anions of carboxylic acids. Acta chimica slovenica, ISSN 1318-0207. [Tiskana izd.], 2007, vol. 54, no. 1, str. 210-215.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIČNO USPOSABLJANJE
Course Title:	PRACTICAL TRAINING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2. ali 3.**	**/**
USP Chemistry, 1st Cycle	**/**	**2nd or 3rd**	**/**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: PRUSP

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	/	/	/	150	/	5

Nosilec predmeta / Lecturer: doc. dr. Martin Gazvoda / Dr. Martin Gazvoda, Assistant Professor

Jeziki / Languages:

Predavanja / Lectures:	**/**
Vaje / Tutorial:	**/**

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

Vsebina:	Content (Syllabus outline):
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. Vsebina prakse se prilagaja konkretnemu mestu kjer se opravlja. Področja na katerih študent lahko opravlja prakso so:	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, • learning about a technological process or

- 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.	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:**
<u>Znanje in razumevanje</u> 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.	<u>Knowledge and Comprehension</u> 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.

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 multidisciplinarnih projektih in mu razvija profesionalno etično in okoljsko odgovornost.	Application Student can use and apply his practical knowledge and abilities during his further education and professional development.
Refleksija Študent je sposoben kritično analizirati in primerjati različne pristope pri reševanju problemov tako na laboratorijskem kot tudi industrijskem nivoju.	Analysis Student is capable critically compare and evaluate different approaches for problem solving in laboratory as well as in industrial on-line environment.
Prenosljive spretnosti Usposabljanje v konkretnem delovnem okolju mu razvija sposobnost za analitično naravoslovno tehnično vrednotenje dogajanj v praksi.	Skill-transference Ability 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 (v %) / Weight (in %)	**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.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ ANALIZNE KEMIJE
Course Title:	PRACTICAL COURSE IN ANALYTICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**3.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**3rd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE113

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

Nosilec predmeta / Lecturer: prof. dr. Irena Kralj Cigić / Dr. Irena Kralj Cigić, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Spoznavanje klasičnih in nekaterih osnovnih instrumentalnih metod analizne kemije. Praktični pristopi k pripravi in analizi vzorca ter identifikaciji motenj pri analizi. Priprava vzorca za analizo: odvzem vzorca, homogenizacija, določanje vlage v vzorcu, raztapljanje vzorca, razklop netopnih vzorcev. Metode identifikacije sestavin in metode za odstranjevanje motenj: -obarjanje, filtracija, ekstrakcija, maskiranje motečih zvrsti, ionska izmenjava. Praktični pristopi v kvantitativni analizi: -validacija analizne opreme (birete, pipete, bučke, ..); -tehtanje, priprava raztopin (raztapljanje,	Classical and some basic instrumental analytical techniques. Practical approaches to sample preparation and analysis, identification of interferences. Preparation of samples: sampling, homogenization, moisture determination, dissolving, digestion of insoluble samples. Identification of constituents and interference removal: -precipitation, filtration, extraction, interference masking, ion exchange. Practical approaches to quantitative analysis: -analytical equipment validation (burettes, pipettes, flasks,...), -weighing, preparation of solutions (dissolving, dilution, stabilization),

razredčevanje, stabiliziranje); -priprava kalibracijskih standardov in umeritvene krivulje; -kvantifikacija s standardnimi dodatki; -statistična analiza rezultatov; -gravimetrična analiza in viri napak (pogoji obarjanja, homogeno obarjanje, motnje); -volumetrična analiza: standardizacija titrnih reagentov, tipi titracij: nevtralizacijska, redoks, kompleksometrična, obarjalna; titracijska krivulja, detekcija končne točke (z barvnimi indikatorji, potenciometrična, amperometrična, fotometrična), motnje in napake; titratorji. -*analiza realnih vzorcev (*določitev glavnih sestavin in sestavin v sledovih): -*gravimetrija in volumetrija;* -*spektroskopske metode*: molekulska absorbcijska in fluorescenčna spektrometrija, plamenska emisijska spektrometrija; -*elektrokemijske metode:* potenciometrija (steklena in druge iono selektivne elektrode), elektrogravimetrija, kulometrija; -*separacijske metode:* ionska izmenjava, tekočinska kromatografija, ekstrakcija.	-preparation of calibration standards and calibration curve, -standard addition method, -statistical analysis of results. -gravimetric analysis and error sources (precipitation conditions, homogenic precipitation, interferences). -Volumetric analysis: reagent standardization, neutralization, redox, complexometric, precipitation titrations, approaches to final point detection (colour indicators, potentiometric, amperometric, photometric detection), titration error, automatic titrator. -*Real sample analysis* (principal and trace component determination): *gravimetric and volumetric determination;* -*Spectroscopic methods*: molecular, flame emission and absorption spectroscopy. -*Electrochemical methods*: potentiometry (glass and other ion selective electrodes), electrogravimetry, voltammetry, amperometry; -*Separation methods*: ion exchange, liquid chromatography, extraction.

Temeljna literatura in viri / Readings:

Praktikum iz analizne kemije, H. Prosen, I. Kralj Cigić, M. Strlič, UL FKKT, 2012.

Dodatna literatura:

Fundamentals of Analytical Chemistry, D. A. Skoog, D. M. West, F.J.Holler, S.R. Crouch, Brooks/Cole, 2004.

Quantitative Chemical Analysis, D. C. Harris, 5th ed., Freeman, New York, 1999.

Cilji in kompetence:	**Objectives and Competences:**
Cilj praktikuma je usposobiti študente za delo v analiznem laboratoriju. To vključuje uporabo klasičnih in nekaterih osnovnih instrumentalnih analiznih metod. Študenti naj bi spoznali prednosti in pomanjkljivosti posameznih metod in se naučili kritično primerjati z njimi pridobljene rezultate. Pridobili naj bi zmožnost samostojne izbire in uporabe primerne analizne metode za	**Learning outcomes:** Knowledge of specific requirements in an analytical laboratory. Application of classical and basic instrumental analytical techniques, knowledge of their advantages and disadvantages. Choice of appropriate technique for specific analytical problems and critical evaluation of the results. Ability of independent usage of appropriate analytical method for

reševanje specifičnih analiznih problemov. Spoznali naj bi elemente dobre laboratorijske prakse. Študenti si pri predmetu pridobijo naslednje specifične kompetence: - usposobljenost za samostojno pripravo raztopin vzorcev in reagentov; - usposobljenost za samostojno izvajanje klasičnih in preprostejših instrumentalnih metod analizne kemije; - zmožnost izbire najprimernejše analizne metode za reševanje specifičnih analiznih problemov in izvedbe analize po standardnih postopkih; - kritično vrednotenje rezultatov, dobljenih z uporabljenimi metodami; - zmožnost ocene napake in prispevka motenj na rezultat analize pri uporabljeni metodi; - usposobljenost za izračun in podajanje končnih rezultatov ter pisanje poročil o analizi.	solving specific analytical problem. Knowledge of the elements for good laboratory practice. **Competences:** -Ability to prepare samples and reagents. -Ability to perform classical and basic instrumental analytical methods. -Ability to choose the appropriate analytical method for a specific problem and implementation of method to standard procedures. -Critical evaluation of the results obtained with used analytical methods. -Estimation of errors and interferences with used analytical methods. -Ability to calculate and present analytical results, and to write a report on chemical analysis.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent spozna osnove klasičnih in nekaterih instrumentalnih analiznih metod. Razume prednosti in omejitve posameznih analiznih metod. Ve, kaj lahko vpliva na analizni postopek, pozna vire motenj in napak. Zna izračunati končni rezultat analize, ga statistično ovrednotiti in napisati ustrezno poročilo.	Knowledge and Comprehension To gain basic knowledge about classical and some instrumental analytical techniques. To understand advantages and limitations of specific analytical methods. To obtain influences on analytical procedure, sources of interferences and errors. To calculate final result of analysis and statistically evaluate it. To write appropriate report.
Uporaba Študent zna izbrati najustreznejšo analizno metodo za reševanje konkretnega analiznega problema. Ustrezno pripravi vzorec in potrebne reagente ter izvaja kvalitativne in kvantitativne postopke za analizo vzorcev. Zna delati z nekaterimi analiznimi instrumenti. Preveri, ali so prisotni viri napak in motenj pri določeni analizi.	Application To choose appropriate analytical method for solution of practical analytical problem. To prepare sample and required reagents properly and to perform qualitative and quantitative procedures for sample analysis. To work with some analytical instruments. To verify sources of errors and interferences with specific analysis.
Refleksija Študent kritično vrednoti različne kvalitativne in kvantitativne analizne metode. Zaveda se	Analysis To critical evaluate different qualitative and quantitative analytical methods. Be aware of

kvalitete podatkov, pridobljenih s posameznimi metodami, pomena motenj in možnosti napak.	data quality, obtained with specific methods, importance of interferences and possibility of errors.
Prenosljive spretnosti Študent se nauči natančnosti in pazljivosti pri izvajanju osnovnih delovnih operacij in kemijskih postopkov. Zna pravilno izvajati napisane postopke, voditi laboratorijski dnevnik, preračunavati rezultate in pisati poročila.	Skill-transference Ability To learn precise and careful implementation of basic working operations and chemical procedures. To perform written procedures properly, to keep laboratory diary, to calculate results and write reports.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Praktikum, seminar.	Practical course, seminar.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Vstopni testi pred vsako vajo	**20%**	Entering tests before each practical work
Pisna poročila vaj	**10%**	Written reports on practical work
Izdelava seminarske naloge	**20%**	Preparation of seminar essay
Opravljen zaključni test iz poznavanja teoretičnih in praktičnih vidikov analiznih metod	**50%**	Written exam on theoretical and practical aspects of analytical methods
Ocenjevanje: 6-10 (pozitivno), 1-5 (negativno)		Grading scale: 6-10 (pozitive), 1-5 (negative)

Reference nosilca / Lecturer's references:

- Praktikum iz analizne kemije, H. Prosen, I. Kralj Cigić, M. Strlič, UL FKKT, 2012.
- I. Kralj Cigić, M. Strlič, A. Schreiber, M. Kocjančič, B. Pihlar, Ochratoxin A in wine: its determination and photostability, Anal. Lett., 39 (2006) 1475-1488.
- I. Kralj Cigić, T. Vrščaj Vodošek, T. Košmerl, M. Strlič, Amino acid quantification in the presence of sugars using HPLC and pre-column derivatization with 3-MPA/OPA and FMOC-Cl. Acta Chim. Slov., 55 (2008) 660-664.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ FIZIKALNE KEMIJE
Course Title:	PRACTICAL COURSE IN PHYSICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**4.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE118

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

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

Jeziki / Languages:

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

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

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

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Vaje iz fizikalne kemije:
Razmerje toplotnih kapacitet plina.
Parcialni molski volumen.
Kalorimetrija: (a) Ionizacijska entalpija. (b) Topilna toplota. (c) Sežigna toplota.
Parni tlak tekočin in izparilna entalpija. Vrelni diagram.
Krioskopija: (a) Določanje molske mase s krioskopsko metodo. (b) Znižanje zmrzišča raztopin šibkih in močnih elektrolitov.
Heterogeno ravnotežje.
Galvanski členi: (a) Napetost in notranja upornost galvanskega člena. (b) Termodinamika galvanskega člena. (c) Izkoristek neposredne metanolove gorivne celice. (d) Določanje standardne napetosti

Content (Syllabus outline):

Practical course in physical chemistry :
Ratio of the heat capacity of gas.
Partial molar volume.
Calorimetry : (a) Enthalpy of ionization. (b) Enthalpy of solution (c) a heat of combustion .
Vapor pressure of liquids and enthalpy of vaporization .
Boiling point vs. composition diagrams for systems consisting of two components.
Cryoscopy : (a) Determination of molecular weight (b) Depression of the freezing point of solutions of weak and strong electrolytes.
Heterogenic equilibrium
Galvanic cells : (a) EMF and internal resistance of galvanic cells . (b) Thermodynamics of galvanic cells . (c) Efficiency of the direct

galvanskega člena, standardnega potenciala steklene elektrode in srednjega koeficienta aktivnosti elektrolita v galvanskem členu. (e) Določanje transportnih števil z merjenjem napetosti galvanskega člena. (f) Merjenje pH in pufrska kapaciteta. (g) Potenciometrična titracija. Električna prevodnost raztopin elektrolitov: (a) Prevodnost močnih elektrolitov. (b) Prevodnost šibkih elektrolitov. Transportno število. Viskoznost tekočin. Viskoznost plinov. Difuzija. Protolitsko ravnotežje. Površinska napetost. Adsorpcija na trdnih površinah. Kemijska kinetika: (a) Inverzija saharoze. (b) Hitrost raztapljanja soli.	methanol fuel cell. (d) Determination of the mean activity coefficient of an electrolyte in aqueous solution from the measured EMF of the appropriate galvanic cell. (e) Determination of the ionic transference number from the measured EMF of the appropriate galvanic cell. (f) Measurement of the pH and buffer capacity. (g) Potentiometric titration. Electrical conductivity of electrolyte solutions: (a) Conductivity of strong electrolytes. (b) Conductivity of weak electrolytes. Transference number. Viscosity of liquids. Viscosity of gases. Diffusion. Protolytic equilibrium. Surface tension. Adsorption on solid surfaces. Chemical kinetics : (a) inversion of sucrose. (b) rate of salt dissolution.

Temeljna literatura in viri / Readings:

M. Bončina et al. *Fizikalna kemija - praktikum*. 1. izd. Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo, 2012. XXXII, 227 str., ilustr. ISBN 978-961-6756-32-7.

Cilji in kompetence:	**Objectives and Competences:**
Predmet zajema laboratorijske vaje, ki pokrivajo večino snovi podane na predavanjih iz fizikalne kemije in tako omogoča študentom, da utrdijo in poglobijo že pridobljena znanja iz tega predmeta. Poseben poudarek je dan osvajanju različnih metod merjenja fizikalno kemijskih količin in kritičnemu vrednotenju dobljenih rezultatov.	The subject includes laboratory exercises that cover most of the themes presented in lectures in physical chemistry and thus allows students to consolidate and deepen the existing knowledge in this subject. Special emphasis is given to various methods of measuring physical and chemical quantities and critical evaluation of the results obtained.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Izvedba vrste eksperimentov, ki se nanašajo na ključne segmente na predavanjih podane snovi, omogoča študentu utrditev znanja fizikalne kemije, mu na praktičnih primerih pokaže smisel in pomembnost predmeta ter ga nauči osnovnih tehnik merjenja fizikalno kemijskih količin.	<u>Knowledge and Comprehension</u> Implementation of the experiments that relate to key segments of lectures in physical chemistry enables students to consolidate the knowledge of physical chemistry. Practical examples show the meaning and importance of the subject, and enable students to learn the basic techniques for measuring physical and chemical quantities.

Uporaba Pojmovna in tehnična osvojitev metod merjenja osnovnih fizikalno kemijskih količin, ki jih študentje pridobijo pri opravljanju praktikuma iz fizikalne kemije je predpogoj za razumevanje in uspešno uporabo modernih metod merjenja uporabljenih pri študiju in vodenju različnh naravnih in laboratorijsko ali industrijsko vodenih procesov. Pri opravljanju teh vaj študentje razvijajo tudi nujno potrebeno sposobnost kritične evalvacije rezultatov in izbire najbolj ustrezne merske tehnike.	Application Conceptual and technical mastering of methods of measuring basic physical and chemical quantities that students obtain in their practical course in physical chemistry is a prerequisite for understanding and effectively using modern techniques used in the study of natural, laboratory or industrial processes. In carrying out these exercises students develop the ability to critically evaluate the results and to choose the most appropriate experimental techniques.
Refleksija Po opravljenih vajah iz fizikalne kemije bi morali biti študenti sposobni povezovati temeljne teorije, ki nastopajo v fizikalni kemiji z eksperimentalnimi rezultati.	Analysis After performing the laboratory exercises students should be able to relate fundamental theories in physical chemistry with the experimental results.
Prenosljive spretnosti Pri izvajanju vaj mora vsak študent eksperiment samostojno izvesti ter princip, izvedbo in interpretacijo rezultatov podati v obliki poročila. Poleg tega mora biti med izvajanjem vaje sposoben diskutirati o njeni problematiki. Vse to razvija sposobnost ustnega in pisnega poročanja.	Skill-transference Ability During the lab exercises every student caries out an experiment and interpretation of the results given in the form of a report, independently. In addition, the student must be able to discuss on all subject of the exercise. This develops the student's ability to communicate orally and in written reports.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Laboratorijske vaje s seminarjem.	Seminars, laboratory exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit. Ocenjevalna lestvica: 6 - 10 pozitivno , 1 – 5 negativno		Written and oral exam. 6 - 10 positive , 1 – 5 negative

Reference nosilca / Lecturer's references:

- LAH, Jurij, POHAR, Ciril, VESNAVER, Gorazd. Calorimetric study of the micellization of alkylpyridinium and alkyltrimethylammonium bromides in water. *J. Phys. Chem., B* 2000, 104, 2522-2526.
- LAH, Jurij, MAIER, Norbert M., LINDNER, Wolfgang, VESNAVER, Gorazd. Thermodynamics of binding of (R)- and (S)-dinitrobnzoyl leucine to cinchona alkaloids and their tert-butylcarbamate derivatives in methanol : evaluation of enantioselectivity by spectroscopic (CD, UV) and microcalorimetric (ITC) titrations. *J. Phys. Chem., B* 2001, 105, 1670-1687.
- DROBNAK, Igor, VESNAVER, Gorazd, LAH, Jurij. Model-based thermodynamic analysis of reversible unfolding processes. *J. Phys. Chem., B* 2010, 114, 8713-8722.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ INSTRUMENTALNIH METOD IN INSTRUMENTALNE ANALIZE
Course Title:	PRACTICAL COURSE IN INSTRUMENTAL METHODS AND INSTRUMENTAL ANALYSIS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**5.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE128

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

Nosilec predmeta / Lecturer: prof. dr. Irena Kralj Cigić / Dr. Irena Kralj Cigić, Full Professor
prof. dr. Matija Tomšič / Dr. Matija Tomšič, Full Professor

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

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

Vsebina:	Content (Syllabus outline):
Prvi del praktikuma je namenjen spoznavanju merskih metod in principov merjenja osnovnih fizikalno kemijskih količin: - merjenje tlaka in pretoka; - merjenje in regulacija temperature (termostat); - merjenje električnih količin: I, U, R, L, C; - dinamične karakteristike senzorjev; - določanje karakteristik elektronskih polprevodniških elementov in elektronskih Podsestavov (dioda, tranzistor, usmernik, stabilizator, operacijski ojačevalnik, integrator, A/D in D/A pretvornik);	In the first part of the practicum the student gets acquainted with various experimental methods and measurement principles of basic physic-chemical quantities: - pressure and flow measurements; - temperature measurements and temperature control (thermostat); - measurements of electrical quantities: current, voltage, resistance, inductivity, and capacitance; - dynamic characteristics of sensors; - characteristics of electronic semiconductor elements and electronic instrumental

- strmina steklene elektrode, avtomatska regulacija pH; - določanje karakteristik optičnih elementov; - preizkus pravilnosti delovanja spektrofotometra. Drugi del je namenjen uporabi osnovnih instrumentalnih metod v kemijski analizi: -elektroanalizne metode (amperometrija in voltametrija): separacija in določanje glavnih sestavin, analiza mikrosestavin z voltametrijo in stripping voltametrijo); - spektroskopske metode: karakterizacija materialov z optično emisijsko spektrometrijo, analiza s plamensko atomsko absorpcijsko spektrometrijo in elektrotermično atomsko absorpcijsko spektrometrijo; interference; - separacijske metode (plinska kromatografija z različno detekcijo – FID, ECD, kombinacija plinska kromatografija-masna spektrometrija); - radiokemijske metode (beta, gama štetje, števna statistika); - analiza realnih vzorcev: zajem vzorca, razklopi vzorcev, statistično vzorčevanje in statistično vrednotenje rezultatov.	components (diode, transistor, rectifier, stabilizer, operational amplifier, integrator, A/D and D/A converter); - the slope of the glass electrode and automatic regulation of pH; - characteristics of optical elements; - testing the performance of a spectrophotometer. In the second part of the practicum the student acquires practical knowledge about instrumental methods in chemical analysis: - electroanalytical methods (amperometry and voltametry): separation and determination of major constituents, analysis of microcomponents with voltametry and stripping voltammetry. - spectroscopic methods: characterisation of materials with optical emission spectroscopy, flame atomic absorption spectrometry and graphite furnace atomic absorption spectrometry, interferences. - separation methods (gas chromatography with different detectors – FID, ECD, hyphenated techniques – gas chromatography-mass spectroscopy. - radiochemical methods (beta, gamma counting, counting statistics). analysis of real samples: sampling, sample digestion, sampling statistics and statistical evaluation of results.

Temeljna literatura in viri / Readings:

- Skupina avtorjev/Group of authors: Praktikum iz instrumentalnih metod, interno gradivo.
- Drago Kočar, Rubert Susič: Vaje iz instrumentalne analize, interno gradivo.
- D.A. Skoog, F.J. Holler, T.A. Nieman: Principles of Instrumental Analysis 5th Ed, Saunders College Publishing

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Praktikum je namenjen ilustraciji in verifikaciji tematike predstavljene pri predmetih Instrumentalne metode in	The main goal of this practicum is to offer student a suitable illustration and practical verification of the topics presented in the

Instrumentalna analiza. Prvi del je namenjen spoznavanju zakonitosti merjenja osnovnih fizikalnih količin in spoznavanju zgradbe in delovanja najpomembnejših funkcijskih sklopov inštrumentov, ki služijo zajemanju, ojačenju, preoblikovanju, izboljšanju merilnega signala in optimizaciji razmerja signal/šum (S/N). Drugi del praktikuma je namenjen usposabljanju študentov za delo z zahtevno instrumentacijo v analiznem laboratoriju. Pridobili naj bi zmožnost samostojne izbire in uporabe primerne instrumentalne analizne metode glede na število in vrsto vzorcev, predvideno koncentracijsko območje ter zahtevnost za osebje in instrumentacijo. Navadili naj bi se glavnih vidikov dobre instrumentalne laboratorijske prakse. Študenti si pri predmetu pridobijo naslednje specifične kompetence: - poznavanje osnovnih sestavnih komponent posameznih instrumentov; - zmožnost sestavljanja in povezovanja nekaterih aparatur, ki so namenjene profesionalni uporabi v kemijskih laboratorijih; - pridobivanje praktičnih izkušenj in poglabljanje razumevanja delovanja in karakteristik (tudi omejitev) posameznih aparatur; - razumevanje zmogljivosti in pravilne rabe instrumentov; - usposobljenost za samostojno delo z instrumenti ob uporabi navodil proizvajalca; - zmožnost izbire najprimernejše analizne metode za reševanje specifičnih analiznih problemov; - zmožnost statistično podprtega načrtovanja in realizacije instrumentalnih analiznih postopkov; - usposobljenost za statistično analizo podatkov, njihovo pravilno interpretacijo in izdelavo poročil o meritvah in analizi.	course of *Instrumental Methods* and course of *Instrumental Analysis*. The first part of the practicum is devoted to experimental measurements of basic physicochemical quantities and getting acquainted with the composition and principles of important functional components of the instruments for data acquisition, amplification, modulation, filtering and optimisation of signal-to-noise ratio. The second part (Instrumental Analysis) is devoted to qualify student to be able to work with complex instrumentation in analytical laboratory. Students will gain the appropriate knowledge to be able to select the appropriate instrumental method according to the sample size, number of samples, type of analyte and concentration level. During this practicum the students gain the following competences: - Knowledge on the basic instrumental components of individual instruments. - The skills to combine basic chemical instruments into a working instrumental setup. - Practical skills and enhanced understanding of the basic instrumental functions, characteristics and limitations. - Understanding the capabilities of the instruments and their proper application. - Competency to start working with the instruments based on the instructions from the User Manual. - Competency to select the optimal analytical method for the specific analytical problem. - Competency to plan the instrumental analysis procedures and the corresponding statistical evaluation. Statistical evaluation of experimental data, their proper interpretation and preparation of experimental reports.
Predvideni študijski rezultati:	**Intended Learning Outcomes:**

Znanje in razumevanje Študent pozna merilne metode, funkcionalno zgradbo in delovanje instrumentov in aparatur in glavne instrumentalne analizne metode. Razume fizikokemijske osnove delovanja in nastavitve analiznih instrumentov. Ve, kaj lahko vpliva na analizni postopek, pozna vire motenj in napak. Zna izračunati in preveriti rezultat instrumentalne analize, ga statistično ovrednotiti in napisati ustrezno poročilo.	Knowledge and Comprehension Student is familiar with the measurement techniques, functional composition and operation of the instruments and basic analytical methods. Student understands the physicochemical basics of operation, alignment of the analytical instruments, effects influencing the analytical procedures, and sources of measurement uncertainty and errors. Student is able to calculate and validate the results of instrumental analysis, to treat them statistically, and to prepare the corresponding experimental report.
Uporaba Študent pozna namen in osnove delovanja analiznih instrumentov. S pomočjo navodil proizvajalca je sposoben reproducirati izdelano analizno metodo. Zna pripraviti vzorec, potrebne reagente in poskrbi za kalibracijo in vzdrževanje instrumentov. Pridobljeno znanje bo koristno uporabljal pri svojem strokovnem in raziskovalnem delu ali v praksi.	Application Student is familiar with the basic application of analytical instruments and is able to reproduce an individual analytical method on the basis of instructions for users. Student is able to prepare the samples and reagents, to make the necessary instrumental calibrations and alignments and to apply this knowledge in practical research.
Refleksija Študent kritično reflektira in vrednoti vidike dela z analizno instrumentacijo glede števila vzorcev, cene posamezne analize, zahtevnosti glede kemikalij in osebja. Zaveda se pomena instrumentov, njihovega delovanja in iz od tod izhajajočih prednosti in omejitev.	Analysis Student critically reflects and validates the analytical procedures and instrumentation in terms of the necessary number of samples, costs and difficulty of the analysis, special demands for the personnel and handling of the special chemicals. Student is aware of the importance of the precision instrumentation, their limitations and the corresponding advantages or disadvantages in application.
Prenosljive spretnosti Študent se nauči pristopiti k novi instrumentaciji. Razumevanje konkretnih implementacij fizikokemijskih osnov in drugih splošnih principov v realizaciji konkretnega instrumenta mu omogoča realistično oceno zahtevnost načrtovanja novih instrumentalnih rešitev.	Skill-transference Ability Student gains the knowledge on how to approach to the new instrumentation and/or analytical method. Understanding basic physicochemical concepts behind an individual instrument the student is able to realistically assess the possibility to apply such an instrument in new instrumental solutions.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Praktikum in seminar.	Laboratory practicum and seminar.

Delež (v %) /

Načini ocenjevanja:	Weight (in %)	**Assessment:**
Pisni izpit in uspešno opravljen praktični del iz prvega dela praktikuma (FK).	**50 %**	Written exam and successfully completed practical part in the first part of the practicum (FK).
Pisni izpit in uspešno opravljen praktični del iz drugega dela praktikuma (AK).	**50 %**	Written exam and successfully completed practical part in the first part of the practicum (AK).

Reference nosilca / Lecturer's references:

- Tomšič, M.; Prossnigg, F.; Glatter, O. A thermoreversible double gel: characterization of a methylcellulose and kappa-carrageenan mixed system in water by SAXS, DSC and rheology. J. Colloid Interf. Sci. 2008, 322, 41-50.
- Tomšič, M.; Jamnik, A.; Fritz-Popovski, G.; Glatter, O.; Vlček, L. Structural properties of pure simple alcohols from ethanol, propanol, butanol, pentanol, to hexanol: Comparing Monte Carlo simulations with experimental SAXS data. J. Phys. Chem. B 2007, 111, 1738-1751.
- Tomšič, M.; Bešter-Rogač, M.; Jamnik, A.; Kunz, W.; Touraud, D.; Bergmann, A.; Glatter, O. Nonionic surfactant Brij 35 in water and in various simple alcohols: Structural investigations by small-angle X-ray scattering and dynamic light scattering. J. Phys. Chem. B 2004, 108, 7021-7032.

- MOŽIR, Alenka, GONZALEZ, Lee, KRALJ CIGIĆ, Irena, WESS, Tim J., RABIN, Ira, HAHN, Oliver, STRLIČ, Matija. A study of degradation of historic parchment using small-angle x-ray scattering, synchrotron-IR and multivariate data analysis. Analytical and bioanalytical chemistry, ISSN 1618-2642, 2012, vol. 402, no. 4, str. 1559-1566, doi: 10.1007/s00216-011-5392-6. [COBISS.SI-ID 35750405]
- KRALJ CIGIĆ, Irena, VRŠČAJ VODOŠEK, Tatjana, KOŠMERL, Tatjana, STRLIČ, Matija. Amino acid quantification in the presence of sugars using HPLC and pre-column derivatization with 3-MPA/OPA and FMOC-Cl. Acta chimica slovenica, ISSN 1318-0207. [Tiskana izd.], 2008, letn. 55, št. 3, str. 660-664, graf. prikazi. http://acta.chem-soc.si/55/55-3-660.pdf. [COBISS.SI-ID 29802245]
- KRALJ CIGIĆ, Irena, STRLIČ, Matija, SCHREIBER, André, KOCJANČIČ, Mitja, PIHLAR, Boris. Ochratoxin A in wine : its determination and photostability. Analytical letters, ISSN 0003-2719. [Print ed.], 2006, vol. 39, no. 7, str. 1475-1488, Graf. prikazi. [COBISS.SI-ID 27677957]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ ORGANSKE KEMIJE
Course Title:	PRACTICAL COURSE IN ORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	/	2.	4.
USP Chemistry, 1st Cycle	/	2nd	4th

Vrsta predmeta / Course Type: obvezni / mandatory

Univerzitetna koda predmeta / University Course Code: KE115

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

Nosilec predmeta / Lecturer: doc. dr. Krištof Kranjc / Dr. Krištof Kranjc, Assistant Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Splošno - Varnost pri delu. Osebna zaščitna oprema. Varovanje delovnega prostora in okolja. - Vodenje laboratorijskega dnevnika in pisanje poročil. - Iskanje literaturnih informacij. **Pretvorbe in eksperimenti** Vaje bodo izbrane tako, da bodo zajemale osnovne tipe reakcij v organski kemiji, osnovne eksperimentalne tehnike in osnovne tehnike izolacije, čiščenja in karakterizacije spojin. - Pretvorba pri sobni, povišani in znižani temperaturi. - Pretvorba v mikro količini (0.1–1 mmol). - Pretvorba pod inertno atmosfero. - Delo z brizgami in septami.	**General** - Safety in organic laboratory. Personal protection equipment. Protection of working space and environment. - Taking care of laboratory diary and writing reports. - Search for literature information. **Transformations and experiments** Laboratory experiments are selected in such a way as to include the major types of reactions in organic chemistry, fundamental experimental techniques and basic techniques of isolation, purification and characterization of compounds. - Conversions are carried out at room temperature, with heating or cooling. - Transformations on micro scale (0.1–1 mmol).

	- Reactions under inert atmosphere. - Work with syringes and septum.

Temeljna literatura in viri / Readings:

Temeljna literatura in viri:

D. Dolenc: Praktikum iz organske kemije, UL FKKT, 2016 (ISBN: 978-961-6756-38-9).

Dodatna literatura:

1) P. B. Cranwell, L. M. Harwood, C. J. Moody: Experimental Organic Chemistry, 3. izdaja, Wiley, 2017 (ISBN: 978-1-119-95239-8).
2) J. Leonard, B. Lygo, G. Procter: Advanced Practical Organic Chemistry, 3. izdaja, CRC Press, 2013 (ISBN: 978-1-4398-6097-7).
3) J. R. Dean, A. M. Jones, D. Holmes, R. Reed, J. Weyers, A. Jones: Practical Skills in Chemistry, 2. izdaja, Prentice Hall, Harlow, 2011 (ISBN: 978-0-273-73118-4).
4) L. F. Tietze, T. Eicher, U. Diederichsen, A. Speicher: Reactions and Syntheses in the Organic Laboratory, Wiley-VCH, Weinheim, 2007 (ISBN: 978-3-527-31223-8).
5) J. W. Lehman: Operational Organic Chemistry, Prentice-Hall, 1999.

Cilji in kompetence:

Cilji predmeta:

Učna enota se tesno navezuje na predmeta Organska kemija I in II. Študent z eksperimentalnim delom praktično nadgradi osnovno teoretično znanje organske kemije in pridobi osnovne veščine, ki so potrebne za eksperimentalno delo v laboratoriju za organsko kemijo.

Predmetno specifične kompetence:

- Varno delo v laboratoriju za organsko kemijo.
- Priprava in izvedba enostavnih in nekaterih srednje zahtevnih eksperimentov v organski kemiji.
- Izvajanje standardnih sinteznih operacij.
- Izvajanje standardnih laboratorijskih tehnik za izolacijo in čiščenje organskih spojin.
- Poznavanje osnov analitike in karakterizacije organskih spojin.
- Dostopanje do literaturnih virov in njihova uporaba.

Objectives and Competences:

Objectives of the course:

The course is closely connected with courses Organic chemistry I and II. Experimental work in laboratory will enable students to enrich their fundamental theoretical knowledge of organic chemistry and to gain common laboratory skills that are necessary for experimental work in organic chemistry.

Competences specific for the course:

- Safety during the work in organic chemistry laboratory.
- To prepare and carry out simple and some intermediately demanding organic chemistry experiments.
- To carry out standard synthetic operations.
- To execute standard laboratory techniques for isolation and purification of organic compounds.
- To get acquainted with basic principles of analysis and characterization of organic compounds.
- Access to literature sources and their application.

Predvideni študijski rezultati:

Intended Learning Outcomes:

Znanje in razumevanje: **Znanje:** - Varno delo v laboratoriju za organsko kemijo. - Priprava in izvedba pretvorb in eksperimentov v organski kemiji. - Izolacija, čiščenje in karakterizacija organskih spojin. - Dostopanje do literaturnih virov in njihova uporaba. **Razumevanje:** - Osnovne in srednje zahtevne eksperimentalne postopke in pretvorbe v organski kemiji. - Teoretske osnove postopkov za izolacijo, čiščenje in karakterizacijo organskih spojin. - Osnovna pravila varnega dela v laboratoriju.	Knowledge and understanding: **Knowledge:** - Safe work in organic chemistry laboratory. - To plan and carry out transformations and experiments in organic chemistry. - Isolation, purification and characterization of organic compounds. - Access to literature sources and their application. **Comprehension:** - Simple and intermediately demanding experimental procedures and transformations in organic chemistry. - Theoretical background necessary to comprehend isolation, purification and characterization procedures of organic compounds. - General rules of safe conduct in a laboratory.
Uporaba: Osnovno praktično znanje organske kemije je temeljno znanje, ki se uporablja v nadaljnjem študiju kemije hkrati pa je nujno potrebno vsakemu kemiku pri njegovem kasnejšem delu v praksi.	Application: Basic practical knowledge of organic chemistry is a fundamental skill, that will be necessary during further studies of chemistry; concomitantly it is also a necessity for every chemist at his or her future work in praxis.
Refleksija: Študent bo na osnovi pridobljenega znanja sposoben izvesti enostavne in srednje zahtevne eksperimente in pretvorbe v organski kemiji. S tem je sposoben preveriti hipoteze v praksi oziroma kritično ovrednotiti rezultate eksperimenta glede na skladnost s teoretičnimi načeli. Študent je načeloma sposoben samostojno poiskati relevantne literaturne vire ter sintetizirati, izolirati, očistiti in okarakterizirati organske spojine.	Reflection: With the knowledge gained, the student will be able to carry out simple and intermediately demanding experiments and transformations in organic chemistry. This will enable him or her to practically test the hypothesis set beforehand and to critically evaluate the results of an experiment in comparison with theoretical principles. Students are generally able to independently find relevant literature sources, to synthesize, isolate, purify and characterize organic compounds.
Prenosljive spretnosti: - Dostopanje do literaturnih virov. - Zbiranje, interpretacija in kritično vrednotenje podatkov. - Identifikacija in reševanje problemov. - Poročanje. - Kritična analiza, sinteza.	Skill-transference Ability: - Access to literature sources. - Gathering, interpreting and critically evaluating data. - Identifying and solving problems. - Preparing reports. - Critically analysing data; synthesis of data.

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

Predavanja, laboratorijske in seminarske vaje.	Lectures, laboratory exercises, seminar.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljen seminar (literaturni preparat) in končni pisni izpit. pozitivna ocena 6-10, negativna ocena 5.		Completed seminar (literature preparation) and final written exam. Pass grade 6-10, fail grade 5.

Reference nosilca / Lecturer's references:

1. Krištof KRANJC, Franc PERDIH, Marijan KOČEVAR: Effect of ring size on the *exo*/*endo* selectivity of a thermal double cycloaddition of fused pyran-2-ones. *Journal of Organic Chemistry*, ISSN 0022-3263, **2009**, vol. 74, no. 16, str. 6303–6306, doi: 10.1021/jo9011199. [COBISS.SI-ID 30678277]
2. Krištof KRANJC, Marijan KOČEVAR: Ethyl vinyl ether as a synthetic equivalent of acetylene in a DABCO-catalyzed microwave-assisted Diels–Alder-elimination reaction sequence starting from 2*H*-pyran-2-ones. *Synlett*, ISSN 0936-5214, **2008**, no. 17, str. 2613–2616, graf. prikazi. http://www.thieme-connect.com/ejournals/abstract/synlett/doi/10.1055/s-0028-1083515, doi: 10.1088/s-0028-1083515. [COBISS.SI-ID 29447685]
3. Krištof KRANJC, Marijan KOČEVAR: An expedient route to indoles *via* cycloaddition/cyclization sequence from (*Z*)-1-methoxybut-1-en-3-yne and 2*H*-pyran-2-ones. *Tetrahedron*, ISSN 0040-4020. [Print ed.], **2008**, vol. 64, no. 1, str. 45–52, doi: 10.1016/j.tct.2007.10.099. [COBISS.SI-ID 29109765]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ SPLOŠNE IN ANORGANSKE KEMIJE
Course Title:	LABORATORY PRACTICE IN GENERAL AND INORGANIC CHEMISTRY

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE104S

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	**/**	**60 SV + 90 LV**	**/**	**/**	**150**	**10**

Nosilec predmeta / Lecturer: prof. dr. Franc Perdih / Dr. Franc Perdih, Full Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Na seminarjih se z računskimi vajami utrjuje znanje kemijskega računanja, potrebnega za izvedbo posameznih laboratorijskih vaj in se sproti preverja znanje študentov pred posamezno praktično vajo. Ob vseh laboratorijskih 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 ter računanje pri titracijah, topnosti snovi, kemijsko ravnotežje, protolitska ravnotežja in redoks reakcije. V laboratoriju se študenti	The knowledge on chemical calculations is refreshed during seminars .This knowledge is required to perform individual laboratory practice, and is tested before each practical laboratory session. 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. At the beginning of the course, students are introduced to safety rules. Then they individually perform 22 laboratory practices (11 in each semester),

najprej seznanijo z varnostnimi pravili dela. Nato samostojno izvedejo 22 praktičnih vaj (11 v vsakem semestru), ob katerih se naučijo osnovne veščine praktičnega laboratorijskega dela kot so npr: izparevanje, filtracija, sušenje, sinteza spojin, merjenje prostornine plinov in tekočin, priprava raztopin, merjenje gostote tekočin, itd. Z uporabo kemijskega računanja znajo kvantitativno ovrednotiti svoje meritve pri praktičnih vajah, na podlagi opazovanj pri kvalitativnih poskusih znajo povezati praktične izkušnje z osnovnimi kemijskimi zakonitostmi.

Vsebine praktičnih vaj: Formule kemijskih spojin. Masna in množinska razmerja snovi. Kemijska reakcija, prebitek reaktantov, izkoristek kemijski reakciji. Plini. Povprečna molska masa plinske zmesi. Priprava raztopin iz trdnih topljencev. Mešanje raztopin. Reakcije med raztopinami kislin in baz. Topnost snovi. Prekristalizacija. Sinteza $FeSO_4 \cdot 7H_2O$. Kemijsko ravnotežje. Določevanje ravnotežne konstante K_c. Protolitska ravnotežja v vodnih raztopinah. Protolitska ravnotežja v raztopinah soli. Določanje mase amonijevega klorida v raztopini. Ionske reakcije. Topnostni produkt. Amfoterne snovi. Redoks reakcije. Koordinacijske spojine. Sinteza CuI. Sinteza in karakterizacija $K_2[Cu(C_2O_4)_2] \cdot 2H_2O$.

where they learn basic skills of practical laboratory work such as evaporation, filtration, drying, synthesis of compunds, volume measurement of gases and solutions, solution preparation, measurement of solution density, etc. With the help of the acquired knoweldge of chemical calculation, they are able to evaluate the measurements obtained during practices. They are able to link practical experience, obtained during observations of qualitative experiments, with basical chemical laws.

Content of laboratory experiments: Formulae of chemical compounds. Molar and mass ratios. Chemical reaction, limiting reactant, yield of chemical reaction. Gases. Average molar mass of gas mixtures. Preparation of solutions from solid solutes. Mixing of solutions. Reactions between acids and bases. Solubility. Recrystalization. Synthesis of $FeSO_4 \cdot 7H_2O$. Chemical equilibrium. Determination of equilibrium constant K_c. Ionization in water solutions. Ionization in salt solutions. Determination of ammonium chloride mass dissolved in solution. Ionic reactions. Solubility product. Amphoteric substances. Redox reactions. Coordination compounds. Synthesis of CuI. Synthesis and characterization of $K_2[Cu(C_2O_4)_2] \cdot 2H_2O$.

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:

Cilji: Znati in uporabljati osnovno kemijsko računanje ter osnovne kemijske zakonitosti. Obvladati principe varnega dela v laboratoriju, različne metode dela, oziroma pristope pri praktičnem delu v laboratoriju.
Kompetence: Znajo varno ravnati z kemikalijami, poznajo varnostne zahteve in ukrepe v laboratoriju; spoznajo in obvladajo različne osnovne metode laboratorijskega dela; znajo samostojno izvajati posamezne

Objectives and Competences:

Objectives: The student is familiar with and knows how to apply basic chemical calculations and fundamental laws of chemistry. They also master the principles of safe laboratory practice, different methods and approaches to practical laboratory work.
Competences: Working safely and autonomously in a laboratory. Ability to use different methods of basic laboratory work. Ability to apply knowledge of basic chemical

eksperimente; so sposobni kritično ovrednotiti določene meritve in/ ali dobljene rezultate pri kemijskem računanju.	calculations in solving practical problems in the laboratory. Ability to critically evaluate measurements and the results obtained from chemical calculations.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent osvoji osnovno praktično znanje varnega dela v kemijskem laboratoriju ter zna osnove kemijskega računanja uporabiti pri kvantitativnem vrednotenju določenih eksperimentov.	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.
Uporaba Pridobljena znanja oziroma spretnosti pri laboratorijskem delu, znanje postopkov in pristopov pri reševanju nalog pri kemijskem računanju so temelji predmetom pri nadaljnjem študiju.	Application Knowledge and skills gained through laboratory practice, and the knowledge of procedures and approaches used to solve chemical calculation problems provide a foundation for further studies.
Refleksija Študent je sposoben kritično ovrednotiti izvedene meritve in oceniti dobljene rezultate pri tem pa razvija sposobnosti za samostojno laboratorijsko delo. Teoretične naloge zna povezati z eksperimentalnimi meritvami in se tako nauči povezovanja teorije in prakse.	Analysis The student can critically evaluate measurements and results while developing the skills required for independent laboratory work. They understand the link between theoretical exercises and experimental measurements and thus learn to connect theory and practice.
Prenosljive spretnosti Študent pridobi praktične laboratorijske spretnosti in izkušnje, znanje kemijskega računanja ter zna uporabljati strokovni jezik (pisno in ustno).	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:**
Sodelovalno učenje / poučevanje ter problemsko delo na seminarjih. Sprotno preverjanje znanja na vsakem seminarju (pisno). Pisni pregledni kolokviji ob zaključku določene vsebinske teme predmeta. Laboratorijske vaje, zasnovane na individualnem delu študenta ter delno s timskim delom. Pisanje laboratorijskega dnevnika.	Collaborative learning/teaching and problem solving at seminars. Short written evaluation of the students' knowledge before every laboratory practice. Comprehensive written midterm exams at the end of each topic. Laboratory practice based on the students' individual work and group work. Laboratory journal.

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

- pisni izpit (nadomestijo ga lahko trije pozitivno ocenjeni kolokviji) - uspešno opravljena pisna preverjanja pred vsako vajo (vstopni testi) - opravljene vaje so pogoj za pristop k izpitu Ocene: pozitivno 6–10; negativno 1–5		- written examination (can be replaced by three positively evaluated midterm exams) - positive grades in pre-lab tests - completed laboratory practice is prerequisite for the examination Grades: 6–10 pass, 5 fail

Reference nosilca / Lecturer's references:

1. D. Sanna, J. Palomba, G. Lubinu, P. Buglyó, S. Nagy, F. Perdih, E. Garribba: Role of ligands in the uptake and reduction of V(V) complexes in red blood cells. J. Med. Chem. 2019, 62, 654–664.
2. T. Koleša Dobravc, K. Maejima, Y. Yoshikawa, A. Meden, H. Yasui, F. Perdih: Bis(picolinato) complexes of vanadium and zinc as potential antidiabetic agents: synthesis, structural elucidation and in vitro insulin-mimetic activity study. New J. Chem. 2018, 42, 3619–3632.
3. T. Koleša Dobravc, E. Lodyga-Chruscinska, M. Symonowicz, D. Sanna, A. Meden, F. Perdih, E. Garribba: Synthesis and characterization of VIVO complexes of picolinate and pyrazine derivatives. Behavior in the solid state and aqueous solution and biotransformation in the presence of blood plasma proteins. Inorg. Chem. 2014, 53, 7960–7976.
4. F. Perdih: Benzoylacetonate and its fluorinated derivatives as ligands for Co(II) complexes : the effect of the presence of fluorine atoms on the crystal packing. Struct. Chem. 2014, 25, 809–819.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRINCIPI ZELENE KEMIJE
Course Title:	PRINCIPLES OF GREEN CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**3.**	**6.**
USP Chemistry, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI8

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

Nosilec predmeta / Lecturer: izr. prof. dr. Jernej Iskra / Dr. Jernej Iskra, Associate Professor
prof. dr. Marjan Jereb / Dr. Marjan Jereb, Associate Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Paradigma zelene kemije: Principi zelene kemije, trajnostni razvoj, krožno gospodarstvo. **Metrika zelene kemije:** Ovrednotenje okoljskih parametrov reakcije, atomska ekonomija, E-faktor, LCA… **Alternativna topila** (voda, ionske tekočine, superkritična topila, organska topila). **Alternativni procesi in aktivacija** (kataliza, katalizatorji na trdnih nosilcih, biokataliza, encimi, mikrovalovi, ultrazvok, fotokemija, elektrokemija). **Biomasa kot vir kemikalij** (biorafinerije).	**The paradigm of Green Chemistry**: Principles of green chemistry, sustainable development, circular economy. **Green Chemistry Metrics**: Assessment of environmental parameters of reaction, atom economy, E-factor, LCA… **Alternative solvents** (water, ionic liquids, supercritical solvents, organic solvents). **Alternative processes and activation** (catalysis, solid supported catalysis, biocatalysis, enzymes, microwaves, ultrasound, photochemistry, electrochemistry). **Biomass as source of chemicals** (biorefineries).

Temeljna literatura in viri / Readings:

***Green Chemistry: An Introductory Text*, Mike Lancaster,** 2. izd., RSC Publishing, 2010.
Dopolnilna literatura
***Introduction to Chemicals from Biomass*, James H. Clark, Fabien Deswarte,** Wiley, 2008.
***Green Chemistry Metrics: A Guide to Determining and Evaluating Process Greenness*, Andrew Dicks, Andrei Hent,** Springer, 2015.

Cilji in kompetence:

Cilj predmeta je razvijati zavest o še donedavna zapostavljenem vidiku kemije, ki posveča poseben poudarek 'sredstvom' ne samo 'cilju'. Eno od temeljnih vodil zelene kemije je optimizacija vsake stopnje oz. postopka v nekem procesu do te mere, da ima čim manjši vpliv na okolje (količina topil, presežki reaktantov, postopek izolacije in čiščenja), da je energetsko nepotraten (npr. mikrovalovna aktivacija namesto termične) in kot celota tudi čim bolj ekonomsko upravičen. Študenti si pri predmetu pridobijo naslednje **specifične kompetence**:
- vsaj delno premagovanje nekaterih stereotipov v kemiji
- praktičen pristop in izvedba transformacij pod 'zelenimi' pogoji
- kritičnost presoje pri izbiri metod in tehnik za izolacijo in čiščenje produktov
- osnove načrtovanja in možnosti alternativnih sinteznih pristopov
- okrepitev ozaveščanja o globalnem problemu varovanja okolja

Objectives and Competences:

Learning outcomes: Development of knowledge of the so far neglected aspect of chemistry which devotes attention to 'means' and not only to 'aims.' One of the fundamental principles of Green Chemistry is optimization of each step or a proceeding in a certain process to minimize the impact on the environment. The amount of solvents, excess of reactants, isolation and purification procedure, energy efficiency (microwave activation instead of thermal, for example) and economic viability are the governing parameters in this regard.
Competences: Overcoming some stereotypes in chemistry; Practical approach and realization of transformation under 'green' conditions; Critical judgement in choosing isolation and purification methods and techniques; Base planning and alternative synthetic approaches. Strengthen the perception of the global protection of the environment.

Predvideni študijski rezultati:

Znanje in razumevanje
Poleg spoznanja načel zelene kemije študenti pridobijo osnovno znanje in razumevanje postopkov in transformacij pod pogoji, ki so okolju prijazni. Pridobijo osnove o alternativnih in obnovljivih reakcijskih medijih, reagentih in katalizatorjih. Spoznajo se z nekaterimi manj pogosto obravnavanimi reakcijskimi sistemi.

Uporaba
Področje zelene kemije je eno novejših, hitro se razvijajočih področij, in hkrati trendov v kemiji. Grozeče, ponekod že katastrofalne posledice človekovega nepremišljenega

Intended Learning Outcomes:

Knowledge and Comprehension
Besides cognition of the Green Chemistry principles, students acquire basic knowledge and comprehension of proceedings and transformations under environmentally friendly conditions. They acquire a basic knowledge on alternative and recyclable reaction media, reagents and catalysts. They get some insight into less discussed reaction systems.

Application
The field of Green Chemistry is one of a novel, fast developing areas and, simultaneously, trends in chemistry. Horrible and in some cases yet disastrous consequences of inconsiderate

delovanja, bodo človeštvo prisilile v mnogo bolj preudarno ravnanje. Težišče vsesplošnega razvoja v kemiji bo po vsej verjetnosti vedno močneje povezano z načeli zelene kemije.	human actions are going to force the mankind to act much more prudent. The focus of the common development in the future is likely going to be more and more strongly linked with the Green Chemistry principles.
Refleksija Študenti se seznanijo z osnovami in problematiko zelene kemije, nadgradijo klasično pojmovanje kemije, analizirajo in primerjajo strategije in pristope klasične in zelene kemije.	Analysis Students acquire basic knowledge and problems of Green Chemistry, and they upgrade the 'classical' comprehension of chemistry. They analyse and evaluate 'classical' and Green Chemistry strategies and approaches.
Prenosljive spretnosti Študent pridobi osnove kritične presoje in ocene postopkov ali procesov z vidika standardov, ki se nanašajo na varovanje in zaščito okolja. Utrdi znanje in spretnosti o praktičnem delu in dobri laboratorijski praksi.	Skill-transference Ability Students acquire the basics of critical judgement and evaluation of proceedings or methods from the viewpoint of protection of environment. They deepen their knowledge and skills of experimental work and good laboratory practice.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarske in laboratorijske vaje.	Lectures, seminars and laboratory work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- opravljene laboratorijske vaje in kolokvij iz vaj - pisni izpit: pozitivno (6-10); negativno (1-5)		- accomplished laboratory work - test - written exam

Reference nosilca / Lecturer's references:

- JEREB, Marjan, ZUPAN, Marko, STAVBER, Stojan. Effective and selective iodofunctionalisation of organic molecules in water using iodine-hydrogen peroxide tandem. *Chem. Commun.*, 2004, 2614-2615.
- JEREB, Marjan. Highly atom-economic, catalyst- and solvent-free oxidation of sulfides into sulfones using 30% aqueous H_2O_2. *Green Chem.*, 2012, 14, 3047-3052.
- JEREB, Marjan, VRAŽIČ, Dejan. Iodine-catalyzed disproportionation of aryl-substituted ethers under solvent-free reaction conditions. *Org. Biomol. Chem.*, 2013, 11, 1978-1999.

- SANZ-MARCO, Amparo, MOŽINA, Štefan, MARTINEZ-ERRO, Samuel, ISKRA, Jernej, MARTÍN-MATUTE, Belén. Synthesis of αα-iodoketones from allylic alcohols through aerobic oxidative iodination. Advanced Synthesis & Catalysis, 2018, 360, 3884-3888, doi: 10.1002/adsc.201800661. [COBISS.SI-ID 1538065091].
- KAWADA, Kosuke, OKANO, Koji, ISKRA, Jernej, KRAJNC, Peter, CAHARD, Dominique.

Selectfluor[sup](TM) on a PolyHIPE material as regenerative and reusable polymer-supported electrophilic fluorinating agent. Advanced Synthesis & Catalysis, 2017, 359, 584-589, doi: 10.1002/adsc.201601312. [COBISS.SI-ID 30090791.

- MOŽINA, Štefan, STAVBER, Stojan, ISKRA, Jernej. Dual catalysis for the aerobic oxidation of benzyl alcohols - nitric acid and fluorinated alcohol. European journal of organic chemistry 2017, 448-452, doi: 10.1002/ejoc.201601339. [COBISS.SI-ID 30184487].

- SLUBAN, Melita, COJOCARU, Bogdan, PÂRVULESCU, Vasile I., ISKRA, Jernej, CERC KOROŠEC, Romana, UMEK, Polona. Protonated titanate nanotubes as solid acid catalyst for aldol condensation. Journal of catalysis, 2017, 346, 161-169, doi: 10.1016/j.jcat.2016.12.015. [COBISS.SI-ID 30232871].

- BEDRAČ, Leon, ISKRA, Jernej. Iodine(I) reagents in hydrochloric acid-catalyzed oxidative iodination of aromatic compounds by hydrogen peroxide and iodine. Advanced Synthesis & Catalysis, 2013, 355, 1243-1248, doi: 10.1002/adsc.201300127. [COBISS.SI-ID 26709799].

- PODGORŠEK, Ajda, EISSEN, Marco, FLECKENSTEIN, Jens, STAVBER, Stojan, ZUPAN, Marko, ISKRA, Jernej. Selective aerobic oxidative dibromination of alkenes with aqueous HBr and sodium nitrite as a catalyst. Green chemistry, 2009, 11, 120-126. [COBISS.SI-ID 22360359].

<UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	RAZVIJANJE SPORAZUMEVALNE ZMOŽNOSTI V SLOVENŠČINI
Course Title:	DEVELOPING COMMUNICATION SKILLS IN SLOVENIAN LANGUAGE

Študijski program in stopnja Study Programme and Level	**Študijska smer Study Field**	**Letnik Academic Year**	**Semester Semester**
UŠP Kemija, 1. stopnja	**/**	**1.**	
USP Chemisrty, 1st Cycle	**/**		

Vrsta predmeta / Course Type: izbirni splošni

Univerzitetna koda predmeta / University Course Code:

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

Nosilec predmeta / Lecturer: doc. dr. Saška Štumberger / dr. Saška Štumberger, Assistant Professor

Jeziki / Languages:

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

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

Vsebina:	**Content (Syllabus outline):**
- kratka predstavitev zgodovine razvoja slovenskih strokovnih besedil, predvsem s področja naravoslovja (npr. Matija Vrtovec, Karl Robida), - predstavitev teorije komunikacijske kompetence v povezavi z aplikativnim vidikom, obravnava odvisnostnega razmerja (in posledic, ki izvirajo iz njega) med tvorjenjem/razumevanjem strokovnega besedila in poznavanjem/upoštevanjem značilnosti govornega položaja oz. sociolingvističnih danosti, - predstavitev besedilotvornih zakonitosti in stilističnih postopkov strokovnih besedil, predvsem s področja kemije, - predstavitev značilnosti strokovnega izrazja	- short presentation of the history of the development of Slovene academic texts, particularly in the field of natural sciences (e.g. Matija Vrtovec, Karl Robida); - presentation of the theory of communication competence in connection with the applied aspect, treatment of the dependent relationship (and the consequences arising from it) between creating/understanding an academic text and knowledge of/taking into account the characteristics of the speech role or sociolinguistic factors; - presentation of the laws of text formation and stylistic procedures with regard to academic texts, particularly in the field of chemistry; - presentation of the characteristics of academic

ter besedotvornih in drugih poimenovalnih postopkov pri strokovnem izrazju, predvsem v povezavi z analizo obstoječe kemijske terminologije. - obravnava jezikovne norme, predvsem tistih poglavij, ki se dotikajo strokovnega jezika s področja naravoslovja, - predstavitev jezikovnih virov (jezikovni priročniki in elektronski viri) in delo z njimi, - na seminarju oz. vajah je predvideno pisanje/tvorjenje strokovnih besedil in njihov pregled.	terminology and word-formational and other terminological procedures in the technical terminology, particularly in connection with the analysis of the existing terminology in chemistry; - treatment of language norms, particularly the chapters that touch upon academic language in the natural sciences; - presentation of linguistic sources (language reference books and electronic sources) and how to work with them, - seminars and exercises will involve the writing/creation of academic texts and their review.

Temeljna literatura in viri / Readings:

- Mateja Jemec Tomazin, 2010: Vloga terminologije pri uveljavljanju znanstvenega področja. V: Vloge središča: konvergenca regij in kultur.
- Mojca Žagar, 2007: Determinologizacija v splošnih in terminoloških slovarjih. V: Razvoj slovenskega strokovnega jezika.
- Mojca Žagar Karer, 2005: Determinologizacija na primeru terminologije fizike. V: Jezik in slovstvo.
- Nataša Jakop, 2001: Nastajanje strokovnih in znanstvenih besedil : med pisanjem in družbenim kontekstom.
- Breda Pogorelec, 1986: Znanstveno besedilo, njegove jezikoslovne prvine in slog. V: Slovenski jezik v znanosti 1.
- Vojko Gorjanc, 2010: Terminološko načrtovanje in upravljanje terminologije. V: Slavistična revija.
- Slovenski pravopis, 2007. ZRC SAZU

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Analiza strokovnega diskurza, predvsem s področja kemije, poznavanje stalnih oblik strokovnih besedil in njihovih besedilotvornih zakonitosti, pregled nekaterih strokovnih besedil s področja kemije, predstavitev značilnosti strokovnega izrazja in poimenovalnih postopkov, obravnava jezikovne norme, pregled in izraba jezikovnih virov. Kompetence: Razumevanje specifičnosti strokovnih besedil, poznavanje strukturnih in stilističnih zakonitosti strokovnih besedil, poznavanje različnih možnosti poimenovalnih postopkov, ustreznih slovenskemu	Objectives: Analysis of academic discourse, particularly in the field of chemistry; familiarity with the standardised form of academic texts and relevant text-formational laws; overview of a number of academic texts in the field of chemistry; presentation of the characteristics of academic terminology and terminological procedures; treatment of language norms; reviewing and making use of language sources. Competences: Understanding the specific nature of academic texts; familiarity with the structural and stylistic laws of academic texts; familiarity with the different possible terminological procedures appropriate to the Slovene academic language; ability to use the

strokovnemu jeziku, zmožnost ustrezno strokovno poimenovati in jezikovno učinkovito oblikovati strokovna besedila.	correct technical terminology and efficiently formulate academic texts.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Poznavanje osnovnih postavk strokovnega diskurza, zmožnost definirati in pojasniti rabo opazovanih jezikovnih sredstev in stilnih postopkov v strokovnih besedilih, razumevanje nujnosti vključitve značilnosti govornega položaja oz. teorije diskurza pri tvorjenju in razumevanju strokovnih besedil.	Knowledge and Comprehension Familiarity with the fundamental premises of academic discourse; ability to define and explain the use of the observed linguistic resources and stylistic procedures in academic texts; understanding the necessity for including the characteristics of the speech role; and the theory of discourse in the comprehension of academic texts.
Uporaba Predmet je pomemben za celovito poznavanje in razumevanje jezikovne stvarnosti	Application The subject is important for comprehensive familiarity with and understanding of the linguistic reality
Refleksija Študenta usposablja za samostojno raziskovanje zakonitosti strokovnega diskurza, obenem pa mu podaja tista jezikovna znanja, ki so potrebno za tvorjenje lastnih strokovnih besedil.	Analysis It qualifies students for independent research into the laws of academic discourse, while giving them the linguistic skills necessary for creating their own academic texts.
Prenosljive spretnosti - zmožnost ustrezno strokovno poimenovati in jezikovno učinkovito oblikovati strokovna besedila.	Skill-transference Ability - ability to use the correct technical terminology and efficiently formulate academic texts.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, vaje, individualno vodeni študij.	Lectures, exercises, self-directed study.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
-seminarska naloga -predstavitev -ustni izpit Pisni izpit; polovico ocene predstavlja opravljena analiza strokovnega besedila in ustna predstavitev rezultatov analize.	**30 %** **20 %** **50 %**	 Written examination; analysis of an academic text and an oral presentation of the analysis results constitutes half the grade.

Reference nosilca / Lecturer's references:

1. ŠTUMBERGER, Saška. Leksikološka opredelitev novejše leksike in terminološka raba v

slovenskem jezikoslovju. Slavistična revija, ISSN 0350-6894. [Tiskana izd.], apr.-jun. 2015, letn. 63, št. 2, str. 249-259. http://www.srl.si/sql_pdf/SRL_2015_2_09.pdf.
2. ŠTUMBERGER, Saška. Besedotvorje novejše slovenske leksike: medponskoobrazilne zloženke. V: ZULJAN KUMAR, Danila (ur.), DOBROVOLJC, Helena (ur.). Zbornik prispevkov s simpozija 2013. Nova Gorica: Založba Univerze, 2015, str. 155-163. http://www.ung.si/media/storage/cms/attachments/2015/05/04/12/45/58/Skrabcev_zbornik8_zbornik.pdf.
3. ŠTUMBERGER, Saška. Kratice v Načrtu pravil za novi slovenski pravopis 1981 in v Slovenskem pravopisu 2001. V: KRŽIŠNIK, Erika (ur.), HLADNIK, Miran (ur.). Toporišičeva obdobja, (Obdobja, ISSN 1408-211X, Simpozij, = Symposium, 35). 1. natis. Ljubljana: Znanstvena založba Filozofske fakultete, 2016, str. 439-446. http://centerslo.si/wp-content/uploads/2016/11/Stumberger.pdf.
4. ŠTUMBERGER, Saška. Sklanjanje kratic v pisnem knjižnem jeziku. V: DOBROVOLJC, Helena (ur.), VEROVNIK, Tina (ur.), ARHAR HOLDT, Špela. Pravopisna razpotja : razprave o pravopisnih vprašanjih. 1. izd. Ljubljana: Založba ZRC, 2015, str. 159-167, 335, 346.
5. ŠTUMBERGER, Saška. Priredne zloženke v slovaropisju. V: SMOLEJ, Mojca (ur.). Slovnica in slovar - aktualni jezikovni opis, (Obdobja, ISSN 1408-211X, Simpozij, = Symposium, 34). 1. natis. Ljubljana: Znanstvena založba Filozofske fakultete, 2015, str. 759-766. http://www.centerslo.net/files/file/simpozij/simp34/zbornik%202/Stumberger.pdf.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SINTEZNA ORGANSKA KEMIJA
Course Title:	ORGANIC CHEMISTRY SYNTHESIS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**4.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KESI2

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

Nosilec predmeta / Lecturer: prof. dr. Franc Požgan / Dr. Franc Požgan, Associate Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Viri in pridobivanje osnovnih kemikalij. **Sinteza in pretvorbe izbranih skupin organskih spojin:** - alkoholi - tioli - amini - karboksilne kisline in njihovi derivati - aldehidi, ketoni in njihovi derivati - alkil halidi - etri - sulfidi **Uporabne sintezne tehnike.** V okviru seminarjev in vaj bodo obdelani primeri sinteze nekaterih enostavnejših	**Sources and production of bulk chemicals.** **Synthesis and transformations of selected classes of organic compounds:** - alcohols - thiols - amines - carboxylic acids and their derivatives - aldehydes, ketones and their derivatives - alkyl halides - ethers - sulfides **Useful laboratory techniques.** The synthesis of selected organic compounds

organskih spojin.	will be performed during seminars and their preparation will be carried out in a laboratory.

Temeljna literatura in viri / Readings:

J. Clayden, N. Greeves, S. Warren, P. Wothers, *Organic Chemistry*, Oxford University Press, Oxford, 2001, 1491 str. (10%)

Dopolnilna literatura:

(a) S. Warren, P. Wyatt: Organic Synthesis – The Disconnection Approach, Wiley, 2008

(b) Literatura za vaje: Vaje iz sintezne organske kemije; interno gradivo kot izročki (Literature for laboratory work: Organic chemistry synthesis laboratory work; internal material as handouts)

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da se študent na primerih enostavnejših sintez nauči uporabljati znanje pridobljeno pri osnovnem kurzu iz organske kemije. **Kompetence:** Kot nadgradnja Praktikuma iz organske kemije se študent nauči tudi zahtevnejših laboratorijskih tehnik in njihove uporabe.	**Learning outcomes:** The ability to use the basic principles of organic chemistry for a directed synthesis of selected classes of organic compounds. **Competences:** The ability to apply more complex laboratory techniques in synthesis.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent zna in razume pretvorbe osnovnih funkcionalnih skupin, s katerimi lahko pripravi določene tipe organskih spojin. Poleg tega poglobi znanje o varnem eksperimentalnem delu.	Knowledge and Comprehension Students gain the knowledge of transformations of basic functional groups for obtaining selected classes of organic compounds. Additionally, they deepen knowledge of safety experimental work.
Uporaba Študent se nauči izbrati najustreznejšo pot za pripravo neke spojine pri uporabi primernih reagentov in reakcijskih pogojev. Prav tako se študent nauči smiselne uporabe nekaterih novih tehnik laboratorijskega dela.	Application Students learn to select the optimal reaction sequence towards target molecule by applying appropriate reagents and reaction conditions. They also learn a rational use of some novel laboratory techniques.
Refleksija Zavedanje, da je osnova sintezne organske kemije natančen študij organskih pretvorb in izbira primernih reakcijskih pogojev.	Analysis To be aware that thorough study of organic transformations and selection of appropriate reaction conditions represents the basis of synthetic organic chemistry.
Prenosljive spretnosti Pri predmetu se študenti z reševanjem različnih problemov izurijo v uporabi organskih reakcij in analitičnega razmišljanja ter v uporabi različnih laboratorijskih tehnik.	Skill-transference Ability By solving different problems, students will be trained to apply the knowledge of organic reactions and analytical thinking as well as to use different laboratory techniques.

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

Predavanja, seminarji in vaje.	Lectures, seminars and laboratory work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit. Opravljene vaje so pogoj za pristop k izpitu.		Written exam. Successfully finished laboratory training for admission to exam.

Reference nosilca / Lecturer's references:

- ŠTEFANE, Bogdan, POŽGAN, Franc. Reactivity of terminal phenylpentenes in a ruthenium-catalyzed cross-metathesis reaction : construction of linear bifunctional C-8 alkenes. *Monatshefte für Chemie*, ISSN 0026-9247, 2013, vol. 144, no. 5, str. 633-640, ilustr. http://download.springer.com/static/pdf/324/art%253A10.1007%252Fs00706-012-0905-3.pdf?auth66=1394015235_1293d9b626d48e1067808ff126455dfc&ext=.pdf, doi: 10.1007/s00706-012-0905-3. [COBISS.SI-ID 36523525]
- ŠTEFANE, Bogdan, POŽGAN, Franc, SOSIČ, Izidor, GOBEC, Stanislav. A microwave-assisted nucleophilic substitution reaction on a quinoline system: the synthesis of amino analogues of nitroxoline : Bogdan Štefane ... [et al.]. *Tetrahedron letters*, ISSN 0040-4039. [Print ed.], 2012, vol. 53, no. 15, str. 1964-1967. http://www.sciencedirect.com/science/article/pii/S0040403912002274?v=s5, doi: 10.1016/j.tetlet.2012.02.017. [COBISS.SI-ID 3200625]
- ŠTEFANE, Bogdan, FABRIS, Jan, POŽGAN, Franc. C-H bond functionalization of arylpyrimidines catalyzed by an in situ generated ruthenium(II) carboxylate system and the construction of tris(heteroaryl)-substituted benzenes. *European journal of organic chemistry*, ISSN 1434-193X, 2011, no. 19, str. 3474-3481, doi: 10.1002/ejoc.201100238. [COBISS.SI-ID 35023109]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SPEKTROSKOPIJA
Course Title:	SPECTROSCOPY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**4.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE134

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

Nosilec predmeta / Lecturer: prof. dr. Janez Košmrlj / Dr. Janez Košmrlj, Full Professor
izr. prof. dr. Barbara Modec / Dr. Barbara Modec, Associate Professor

Jeziki / Languages:

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

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

Vsebina:

Uvod v vibracijsko spektroskopijo
Izvor spektrov, simetrijski elementi, točkovne skupine, simetrija normalnih nihanj in izbirna pravila, osnove teorije grup.
Uporaba vibracijske spektroskopije v anorganski kemiji
Dvoatomarne in troatomarne molekule, piramidalne in planarne štiriatomarne molekule, tetraedrične in kvadratno-planarne petatomarne molekule, oktaedrične molekule; spektri akva, hidrokso in okso kompleksov, spektri kompleksov z anionskimi ligandi kot so sulfat, karbonat, nitrat, oksalat, cianid in halogenid, spektri kompleksov z nevtralnimi

Content (Syllabus outline):

A) introduction to vibrational spectroscopy: spectra, symmetry elements, selection rules. B) application of vibrational spectroscopy in inorganic chemistry: two- and three-atom molecules, pyramidal and planar four-atom molecules, tetrahedral and square-planar molecules, octahedral molecules, complexes with ligands such as water, hydroxide, oxide, sulphate, carbonate, nitrate, nitrosyl, etc. C) application of vibrational spectroscopy in organic chemistry: important IR chromophores (OH, NH, CH, C≡N, C≡C, C=O, C=N, C=C, C-O, C-N, C-X, NO_2), D) introduction to electronic spectroscopy: basic principles, spectra of

ligandi kot so amin, karbonil ali nitrozil.

Uporaba vibracijske spektroskopije v organski kemiji

Pomembni IR kromoforji v organskih spojinah (OH, NH, CH, C≡N, C≡C, C=O, C=N, C=C, C–O, C–N, C–X, NO_2), vpliv konjugiranosti na IR absorpcije.

Uvod v elektronsko spektroskopijo

Izvor elektronskih spektrov, spektri organskih molekul (π–π^* in n–π^* prehodi). Spektri kompleksov kovin prehoda (d-d trakovi, trakovi s prenosom naboja iz kovine na ligand in iz liganda na kovino).

Uporaba elektronske spektroskopije v anorganski kemiji

Spektri oktaedričnih kompleksov, spektri tetraedričnih kompleksov.

Uporaba elektronske spektroskopije v organski kemiji

Kvantitativni aspekti UV spektroskopije, razvrstitev UV absorpcijskih trakov, pomembni UV kromoforji v organskih spojinah, efekt topila, empirična pravila za izračun absorpcijskih trakov.

Uvod v jedrsko magnetno resonanco

Narava jedrskih spinov in NMR instrumentacija, »continuous wave« NMR spektroskopija, »Fourier-transform« NMR spektroskopija, kemijski premiki v ^{1}H NMR sprektroskopiji, spin-spin sklopitve v NMR spektroskopiji

Uporaba NMR v organski kemiji in anorganski kemiji

Analiza ^{1}H NMR spektrov, ^{13}C NMR spektroskopija, sklopitve in nesklopitve v ^{13}C NMR spektrih, določitev multiplikacije ^{13}C NMR spektrov z uporabo DEPT metode, senčenje in značilni kemijski premiki v ^{13}C NMR spektrih, dinamični procesi v NMR spektroskopiji, korelacijska spektroskopija, NMR spektroskopija drugih jeder, vpliv topila, določanje strukture organskih spojin na osnovi NMR spektrov.

Masna spektrometrija

Ionizacijski procesi, instrumenti, fragmentacijski procesi, primeri najpogostejših fragmentacijskih procesov pri osnovnih tipih

organic compounds, spectra of transition metal complexes. E) application of electronic spectroscopy in inorganic chemistry: spectra of octahedral, tetrahedral, and other complexes. F) application of electronic spectra in organic chemistry: quantitative aspects of UV spectroscopy, important UV chromophores, UV absorption bands, solvent effect, empirical rules. G) introduction to nuclear magnetic resonance: chemical shift, coupling, integral, NMR active nuclei, continuous wave vs. pulse NMR. H) application of NMR in organic and inorganic chemistry: analysis of proton and carbon NMR spectra, coupled and decoupled carbon spectra, DEPT, basics of dynamic NMR, an informative overview of correlation spectroscopy, some other relevant nuclei. I) mass spectrometry: ionization processes, instruments, fragmentations, examples of the most important fragmentations in important types of organic compounds (carbohydrates, hydroxyl compounds, ethers, ketones, aldehydes, carbocyclic compounds).

organskih molekul.	

Temeljna literatura in viri / Readings:

- Alan Vincent: Molecular symmetry and group theory. A programmed introduction to chemical applications. John Wiley & Sons, 1996, 156 str. (strani 22-65, 85-102 in 121-138, skupaj 77 strani)
- N. B. Colthup, L. H. Daly and S. E. Wiberley: Introduction to infrared and Raman spectroscopy. Academic Press, 1964, 511 str. (strani 1-37, 168-191, skupaj 60 strani)
- R.M.Silverstein, F.X.Webster. Spectroscopic Identification of Organic Compounds, John Wiley&Sons, 502 str., (izbrana poglavja skupaj 100 strani)

Dodatna literatura:

- K. Nakamoto: Infrared and Raman spectra of inorganic and coordination compounds. Part B: Applications in coordination, organometallic and bioinorganic chemistry, 5th ed., John
D.L.Pavia, G.M.Lampman, G.S.Kriz. Introduction to Spectroscopy, Harcourt College Pub. 2001.

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Seznaniti študenta z najpomembnejšimi spektroskopskimi metodami, ki se uporabljajo v anorganski in organski kemiji, pri čemer je poudarek na osnovah, ki so potrebne za interpretacijo spektrov pri praktičnem delu. Prikazati značilne primere uporabe vibracijske in elektronske spektroskopije, jedrske magnetne resonance in masne spektrometrije pri reševanju problemov v anorganski in organski kemiji, predvsem pa pri določevanju struktur in sestave vzorcev. **Specifične kompetence:** Študent pozna in razume osnovne principe spektroskopskih metod, praktičnega snemanja spektrov in uporabe tega znanja pri karakterizaciji spojin. Eksperimentalne rezultate zna kritično ovrednotiti.	Ability to understand basic principles of spectroscopic methods, techniques for acquiring spectra in characterization of compounds as well as to critically asses the results. Understanding the principles of the most important spectroscopic methods used in inorganic and organic chemistry. Knowledge of basics required for spectral interpretation. Vibrational and electronic spectroscopy, nuclear magnetic resonance, and mass spectrometry in structure elucidation of inorganic and organic compounds.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent spozna osnove spektroskopskih metod in se nauči njihove uporabe pri karakterizaciji spojin.	Knowledge and Comprehension Student learns basics of spectroscopic methods and their application at the characterization of compounds.
Uporaba Pridobljena znanja so nepogrešljiva za karakterizacijo spojin in kot takšna osnova za praktično uporabo in nadaljnje raziskovalno delo.	Application The learned knowledge is indispensable at the characterization of the compounds and further research work.

Refleksija Pridobljena znanja so nepogrešljiva za karakterizacijo spojin in kot takšna osnova za praktično uporabo in nadaljnje raziskovalno delo.	Analysis The learned knowledge is indispensable at the characterization of the compounds and further research work.
Prenosljive spretnosti Študent pri predmetu pridobi specifična praktična znanja o spektroskopskih tehnikah, ki jih lahko uporablja na različnih področjih npr. v analizi živil, farmacevtskih učinkovin, forenzični analizi itn. Nauči se tudi uporabe elektronskih baz, ki vsebujejo IR, NMR in masne spektre.	Skill-transference Ability The gained knowledge finds application in different research areas such as food and drugs analysis, forensic studies, etc. The student also gets familiar with the databases, containing IR, NMR and MS spectra.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, **laboratorijske vaje:** vključujejo delo na FTIR inštrumentu, UV-vidnem, masnem in NMR spektrometru.	Lectures, seminars, practicals. Practicals include acquiring hands on experiences with spectrometers.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit. Ocenjevalna lestvica v skladu z enotno lestvico ECTS na Univerzi v Ljubljani: 6 – 10 opravil izpit 1 – 5 ni opravil izpita		

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.
- J. Košmrlj, S. Kafka, I. Leban, M. Grad: Formation and Structure Elucidation of Two Novel Spiro[2*H*-indol]-3(1*H*)-ones, *Magn. Reson. Chem.* **2007**, *45*, 700–704.
- D. Urankar, A. Pevec, I. Turel, J. Košmrlj: Pyridyl Conjugated 1,2,3-Triazole is a Versatile Coordination Ability Ligand Enabling Supramolecular Associations. *Cryst. Growth Des.* **2010**, *10*, 4920–4927.

- F. A. Cotton, E. V. Dikarev, J. Gu, S. Herrerro, B. Modec: Alkylpyridine complexes of tungsten(II) and chromium(II). First rotational isomers of $W_2X_4L_4$ molecules with D_{2h} and D_2 symmetries. *Inorg. Chem.* **2000**, *39*, 5407–5411.
- B. Modec, D. Dolenc, J. V. Brenčič, J. Koller, J. Zubieta: Dinuclear oxomolybdate(V) species with oxalato and pyridine ligands revisited: *cis/trans* isomerization of $[Mo_2O_4(\eta^2\text{-}C_2O_4)_2(R\text{-}Py)_2]^{2-}$ (R-Py = pyridine, alkyl-substituted pyridine) in water evidenced by NMR spectroscopy. *Eur. J. Inorg. Chem.* **2005**, 3224–3237.
- B. Modec, D. Dolenc, J. V. Brenčič: New molybdenum(V) complexes based on the $\{Mo_2O_4\}^{2+}$ structural core with esters or anions of malonic and succinic acid. *Inorg. Chim. Acta* **2007**, *360*, 663–678.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SPLOŠNA KEMIJA
Course Title:	GENERAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemijsko inženirstvo, 1. stopnja, UŠP Biokemija, 1. stopnja, UŠP Kemija, 1. stopnja	**/**	**1.**	**1.**
USP Chemical Engineering, 1st Cycle, USP Biochemistry, 1st Cycle, USP Chemistry, 1st Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE103

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

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

Jeziki / Languages:

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

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

Vsebina:	**Content (Syllabus outline):**
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	**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).

(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); 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).	**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 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:
- Boris Čeh, Splošna kemija, Založba UL FKKT, Ljubljana 2018, 389 str.

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

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.	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.
Uporaba Znanje in razumevanje osnovnih kemijskih zakonitosti so temelji predmetom pri nadaljnjem študiju.	Application Knowledge and understanding of basic chemical principles are the basis of subjects for further study.
Refleksija Študent je sposoben oceniti pomen osnovnih kemijskih zakonitosti in teoretskega znanja za razlago eksperimentalnih dejstev in lastnosti snovi.	Analysis Student is able to assess the meaning of basic chemical principles and theoretical knowledge for an explanation of experimental facts and properties of compounds.
Prenosljive spretnosti Študent zna poiskati podatke iz strokovne literature, podatke iz virov medmrežja pa zna kritično oceniti; zna uporabljati strokovni jezik (pisno in ustno).	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 (v %) / Weight (in %)	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 $[Eu(cfqH)(cfq)(H_2O)_4]Cl_2.4.55\ H_2O$, 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).

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	STRUKTURA ATOMOV IN MOLEKUL
Course Title:	STRUCTURE OF ATOMS AND MOLECULES

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**3.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**3rd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE119

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

Nosilec predmeta / Lecturer: prof. dr. Tomaž Urbič / Dr. Tomaž Urbič, Associate Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Uvod v kvantno mehaniko. Moderni modeli atoma. Kvantni pojavi. Dvojnost narave. Heisenbergov princip nedoločljivosti. Povezava med klasičnim in kvantnim opisom narave (Bohrov princip korespondence). Pojem diferencialne enačbe in nekateri enostavni primeri, valovna enačba za struno. Opisna razlaga Schrödingerjeve enačbe in zveza med njenimi rešitvami ter verjetnostjo. Uvedba pojma operatorja. **Modelni sistemi**. Kvantni delec v potencialni jami. Tunelski efekt. Enostavni rotatorji in oscilatorji. Prehodi med kvantnimi stanji. Opisno o metodah približnega računanja. **Atomi**. Vodikov in vodiku podoben atom (poudarek na opisu in predstavitvi lastnih	Introduction to quantum mechanics (models of atom, quantum phenomena, Heisenberg principle, wave – particle duality, Schrödinger equation, quantum operators, commutation, expectation values). Model systems (free particle, particle in a box, tunneling effect, rotators, oscillators, transition moments). Approximate calculations (variation methods, perturbation theory). Atoms (hydrogen and helium atom, orbital and spin angular momentum, atoms in magnetic fields, Pauli principle, Hartree-Fock model, electronic configuration, periodic systems). Molecular orbital method, valence bond theory. Molecules (molecular orbitals, maximum overlap principle, hybrid orbitals, Roothaan equations, self

funkcij, energije kot lastne vrednosti, kvantna števila), primerjava z rezultati Bohrovega modela. Orbitalna in spinska vrtilna količina. Paulijev princip in Paulijeve sile. Nameščanje elektronov na energijske nivoje, Hundova pravila. Ionizacijski potenciali, elektronske afinitete, efektivni radiji. Elektronska konfiguracija atomov in periodni sistem. **Metoda valenčnih vezi (VB) in metoda molekulskih orbital (MO).** Metoda valenčnih vezi, sistem H2 z metodo valenčnih vezi. Metoda molekulskih orbital, obravnavanje sistemov H2+ in H2. Povezava med obema pristopoma. **Dvo- in večatomne molekule**. Slike in označevanje molekulskih orbital. Neto valenčnost. Hibridne orbitale (vpeljava in grafična predstavitev). Princip maksimalnega prekrivanja. Dipolni momenti hibridnih orbital. Dipolni momenti molekulskih orbital. Elektronegativnost (definicija, lestvice). Ionski karakter vezi. Večatomne molekule: elektronski problem (poenostavljen opis nastavitve problema in načinov reševanja, zgradba računalniških programov in praktični prikaz reševanja konkratnega primera s pomočjo računalnika). Hückelova metoda (□-□ separacija, aromatičnost in pravilo 4n+2, alternirajoči in nealternirajoči ogljikovodiki). Strukturni indeksi in reaktivnost molekul.	consistent field method, Hückel method).

Temeljna literatura in viri / Readings:

- J. Koller, Struktura atomov in molekul – osnove kvantne mehanike, atomi, FKKT, Ljubljana 2002, 117 str., (100 %)
- J. Koller, Struktura atomov in molekul – molekule, osnove spektroskopije, FKKT, Ljubljana 2000, 114 str., (53 %)
- P.W. Atkins, Physical Chemistry (šesta izdaja), Oxford University Press, Oxford 1998, 998 str., (15%)

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.

Cilji in kompetence:	**Objectives and Competences:**
Predmet je del področja kvantna kemija, ki je uporaba metod kvantne fizike v kemiji. **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**: sposobnost razlage struktur atomov in enostavnih molekul, usmerjanje k samostojnemu teoretičnemu delu.	***Course is part of the quantum chemistry field, which is usage of quantum mechanics methods in chemistry.*** ***Learning outcomes:*** Understanding of the basic principles of quantum mechanics and the use of these principles in learning the new perspective of looking on the micro cosmos. ***Competences:*** Ability to interpret the atomic structure and the structure of simple molecules. Directing of student to the 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 mnogih kemijskih principov, nauči se vrednotiti rezultate teoretičnih računov. Spozna povezavo med klasično in kvantno fiziko.	Knowledge and Comprehension Student will learn about basics of quantum mechanics and abstract thinking that goes with it. He will learn about theoretical aspects of many chemical principles, to evaluate results of theoretical calculations.
Uporaba Poznavanje principov, ki jih posreduje ta predmet, je nujna osnova za vse teoretične študije v kemiji in biokemiji. Študent se spozna z enačbami, s katerimi lahko obravnava atome, molekule in molekulske sisteme, rezultati katerih pa so velikosti fizikalno-kemijskih količin, ki jih lahko primerja z izmerjenimi.	Application Knowledge of principles in the course is needed for all theoretical studies in chemistry and biochemistry. Students will be introduced to equations which are used to describe properties of atoms, molecules and molecular systems and give results of physical quantities which can be compared to experimental ones.
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.	Analysis Student will find out that behaviour of small quantum particles can not be explained from facts from everyday live, but from abstract thinking.
Prenosljive spretnosti 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.	Skill-transference Ability Students will learn how to identify problem, how to solve it from commercial computer programs and critically interpret the results. He will also get acquainted about the field's literature and present results in written form.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja Seminar (računske naloge iz predelane snovi)	Lectures, seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit. Ocene: 6-10 pozitivno. Študent piše dve pisni vaji (računske naloge), dosežena polovica možnih točk mu omogoči oprostitev pisnega izpita. V nasprotnem primeru opravlja pisni izpit iz računskih nalog in ustni izpit.		Written and oral exam. 6-10 pozitive, 1-5 negative

Reference nosilca / Lecturer's References:

- HUŠ, Matej, **URBIČ, Tomaž**. Quantum chemical tests of water-water potential for interaction site water models. Acta chimica slovenica, 2012, vol. 59, no. 3, str. 541-547.

- HUŠ, Matej, **URBIČ, Tomaž**. Strength of hydrogen bonds of water depends on local environment. The Journal of chemical physics, 2012, vol. 136, no. 14, art. no. 144305.

- URBIČ, Tjaša, **URBIČ, Tomaž**, AVBELJ, Franc, DILL, Ken A. Molecular simulations find stable structures in fragments of protein G. *Acta chimica slovenica*, 2008, vol. 55, no. 2, str. 385-395.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	TEHNIŠKA ANGLEŠČINA
Course Title:	TECHNICAL ENGLISH

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**2.**	**3.**
USP Chemistry, 1st Cycle	**/**	**2nd**	**3rd**

Vrsta predmeta / Course Type: **izbirni splošni / Elective General**

Univerzitetna koda predmeta / University Course Code: SI103

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

Nosilec predmeta / Lecturer: Doc. dr. Primož Jurko / Primož Jurko, Assistant Professor, PhD

Jeziki / Languages:	**Predavanja / Lectures:**	angleški / English; slovenski le pri prevodih; Slovenian only when practicing translation
	Vaje / Tutorial:	angleški / English; slovenski le pri prevodih; Slovenian only when practicing translation

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Potrebno je dobro srednješolsko znanje angleščine (B2-C1). Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	B2-C1 level of English is required. The course has to be assigned to the student.

Vsebina:	**Content (Syllabus outline):**
1. Kemiki v naravoslovnih poklicih – poslovne spretnosti za kemike in ključne spretnosti za znanstvene raziskovalce 2. Usvajanje kemijskega besedišča: a) kemijski elementi, njihovi simboli in kemijske spojine b) kemijske formule in enačbe c) laboratorijska oprema d) laboratorijske tehnike e) načrtovanje eksperimenta – postavitev laboratorijske aparature	1. Chemistry careers -- business skills for chemists, and key skills for scientists 2. Chemistry vocabulary acquisition: a) Chemical elements, their symbols and chemical compounds b) Chemical formulae and equations c) Laboratory equipment d) Laboratory techniques e) Designing an experiment – experimental setup 3. Science research reading, writing, publishing,

2. Branje, pisanje, objave in predstavitve v znanstvenem raziskovanju: a) tipi znanstveno-raziskovalnih člankov b) razumevanje znanstveno-raziskovalnih člankov v slovenščini in angleščini c) razlike v strukturiranju znanstveno raziskovalnih člankov v slovenščini in angleščini d) Shema IMRAD in njeni elementi e) Laboratorijski zapiski in poročila f) Objava raziskave v znanstvenih revijah g) Učinkovita ustna predstavitev	and presenting: a) Types of science research articles b) comprehension of science research articles in Slovene and English c) different structuring of articles in Slovene and English d) the IMRAD structure and its elements e) Laboratory notes and reports f) Publishing research in scientific journals g) Giving an effective presentation

Temeljna literatura in viri / Readings:

Temeljna literatura / ESP Chemistry resources:

- Glasman-Deal, Hilary. 2012. *Science Research Writing for Non-Native Speakers of English*. London: Imperial College Press. (Izbrane vsebine / Selected materials).
- Alley, Michael. 2013. *The Craft of Scientific Presentation.* 2nd ed. New York: Springer-Verlag.
- Zeller, Walter. 2008. *ESP:C (English for Specific Purposes: Chemistry).* A Moodle Course, created by the European Partnership and managed by the Astyle, linguistic competence (astyle@aon.at). Available at http://www.astyle.at/esp-c/index.html.
- Armer, Tamzen; Day, Jeremy, Series Editor. 2011. *Cambridge English for Scientists.* Student's Book with 2 Audio CDs. Professional English Series. Cambridge: Cambridge University Press.
- Vukadinovič, Nada. 2005. *Describing Chemical Experiments*. Ljubljana: Naravoslovnotehniška fakulteta, Oddelek za kemijsko izobraževanje in informatiko. Izd. iz 2003 dostopna na / Ed. from 2003 available at http://www.kii.ntf.uni-lj.si/anglescina/doc/Descr%20Chem%20Exp%202003.pdf/. S priloženim CD-romom / With a CD-Rom *English for Chemists*.

Viri / Resources:

- IUPAC Nomenclature. Dostopno na /Available at http://www.iupac.org/home/publications/e-resources/nomenclature-and-terminology.html/. (Izbrane vsebine / Selected materials).
- Barker, Kathy. 2005. *At the Bench: A Laboratory Navigator*. Updated Edition. Cold Spring Harbor, New York: Cold Spring Harbor Laboratory Press, America. (Izbrane vsebine / Selected materials).
- de Chazal, Edward; McCarter, Sam; Rogers, Louis; and Moore, Julie. 2012. *Oxford EAP* (English for Academic Purposes) Upper-Intermediate / B2 . Student Book with CD-ROM & Audio CD. Oxford: Oxford University Press. (Izbrane vsebine / Selected materials).
- Hewings, Martin; McCarthy, Michael, Course Consultant. 2012. *Cambridge Academic English.* An Integrated Skills Course for EAP, B2 Upper Intermediate Student's Book. Cambridge: Cambridge University Press. (Izbrane vsebine / Selected materials).
- Dopolnilni spletni viri, učbeniška besedila ter znanstveni in strokovni članki. / Supplementary web resources, textbook extracts, professional articles and scientific papers.

Cilji in kompetence:	**Objectives and Competences:**
• Usvajanje osnov angleškega strokovnega in znanstvenega jezika, ki se uporablja v kemiji in povezanih področjih (ESP & ESAP in Chemistry) • Urjenje v jezikovnih spretnostih bralnega, slušnega in vizualnega razumevanja, ustnega in pisnega sporočanja ter javnega nastopanja in podajanja ustnih predstavitev	• Acquisition of the basics of English for specific purposes (ESP) and English for specific academic purposes (ESAP), applicable in chemistry and related fields • Practice in the language skills of reading, listening and visual comprehension, of oral and written communication, of public speaking and giving

	presentation

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje • Bralno, slušno, vizualno in avdiovizualno razumevanje vsebin s kemijskih področij •Pisno sporočanje ter govorno sporazumevanje in ustne predstavitve na kemijskih področjih • Kemijska terminologija • Uporaba referenčnih virov	Knowledge and Comprehension • Reading, listening, visual and viewing comprehension of the contents in the chemistry fields • Written communication, oral communication and presentation in the fields of chemistry • Chemistry terminology • Use of reference resources
Uporaba • Pri študiju • V poklicu • Pri sodelovanju z mednarodnimi strokovnjaki in znanstvenimi raziskovalci • Pri pridobivanju samozavesti v interakciji z globalno strokovno in akademsko skupnostjo	Application • In study • At work •In interaction with international professionals and scientific researchers • At gaining assertiveness in the interaction with the global professional and academic community
Refleksija Znanje angleškega jezika je postalo bistvena spretnost, saj jo uporabljamo za vso splošno, strokovno in akademsko komunikacijo v današnjem modernem globalnem svetu.	Analysis Knowledge of English has become a crucial competence which is used in all general, professional and academic communication in today's modern global world.
Prenosljive spretnosti • Urjenje sposobnosti razumevanja, sporočanja in sporazumevanja • Zbiranje specifičnih informacij po različnih virih in sposobnost njihovega umeščanja v širši okvir • • • Učne strategije za razvoj samostojnih udeležencev v procesu vseživljenjskega učenja	Skill-transference Ability • Practice in the skills of comprehension, communication and interaction; • Collecting specific information from different resources and their interpretation in broader context • Learning strategies for the development of competenet participants in life-long learning

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
• predavanja • seminar z ustnimi predstavitvami • avditorne vaje	• lectures • seminar classes with oral presentations • practical language classes

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
I. metode ocenjevanja a) ustna predstavitev z uporabo strokovne terminologije (UP). Opraviti jo je treba v času pedagoškega procesa pri urah seminarja. b) pisni izpit (PI), ki ga je mogoče opraviti bodisi med semestrom z dvema pozitivno ocenjenima kolokvijema bodisi na razpisanih izpitnih rokih	PI = 80 % UP = 20 % WE = 80% OP = 20%	*I. Grading Methods* a) oral presentation (OP) comprizing chemistry terminology. It has to be given at seminar classes during the semester teaching period. b) written exam (WE) that can be done either by successfully passing the Mid-Term and End-of-Term Tests or at regular exam dates

II. struktura končne ocene:
PI (80 %) + UP (20 %) = 100 %

III. ocenjevalna lestvica
a) končna ocena: 6–10 pozitivno,
1–5 negativno

Rezultati [%]	Ocene	Točke
93 – 100	Odlično	10
85 – 92	Prav dobro	9
76 – 84	Prav dobro	8
68 – 75	Dobro	7
60 – 67	Zadostno	6

IV. dokumentacija ocene
Končna ocena predmeta se vpiše v e-indeks kot enotna ocena.

II. The Structure of Final Grade:
WE (80%) + OP (20%) = 100%

III. Grading Scale
a)final grade: 6–10 positive grades,
1–5 negative, i.e. failing grades.

Scores [%]	Grades	Points
93 – 100	Excellent	10
85 – 92	Very good	9
76 – 84	Very good	8
68 – 75	Good	7
60 – 67	Sufficient	6

IV. Grade Documentation
The final grade is submitted into the e-grade academic record as a single grade.

Reference nosilca / Lecturer's references:

JURKO, Primož. Target language corpus as an encoding tool: Collocations in Slovene-English Translator Training. *ELOPE*, ISSN 1581-8918, in press.

-----. Collocation errors in encoding and possible cures : dictionaries vs. corpora. V: ŠORLI, Mojca (ur.). *Dvojezična korpusna leksikografija : slovenščina v kontrastu: novi izzivi, novi obeti*, (Zbirka Trojinski konj). 1. izd. Ljubljana: Trojina, zavod za uporabno slovenistiko, 2012, str. 72-89.

-----. Meaning-text theory in the translator's classroom. *Rivista internazionale di tecnica della traduzione*, ISSN 1722-5906, 2011, n. 13, str. 129-138.

-----. Slovene-English contrastive phraseology : lexical collocations. *ELOPE*, ISSN 1581-8918, autumn 2010, vol. 7, str. 57-73.

-----. Divergent polysemy: the case of Slovene namreč vs. English namely. *ELOPE*, ISSN 1581-8918, 2007, vol. 4, [no.] 1/2, str. 29-41.]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ZGRADBA IN LASTNOSTI TRDNIN
Course Title:	STRUCTURE AND PROPERTIES OF SOLIDS

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KE110

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

Nosilec predmeta / Lecturer: izr. prof. dr. Amalija Golobič /
Dr. Amalija Golobič, Associate Professor

Jeziki / Languages:

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

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

Vsebina:	Content (Syllabus outline):
Amorfna in kristalinična zgradba trdnin, osnove kristalografije (periodičnost kristalov, kristalna mreža, osnovna celica, centriranost, simetrija, simetrijski elementi in njihove kombinacije, točkovne skupine, prostorske skupine). Mehanske, optične, električne in magnetne lastnosti trdnin in njihov izvor. Pregled in primerjava osnovnih strukturnih tipov anorganskih trdnin (kovine in zlitine, najgostejša sklada, strukture elementov, ionske strukture s stehiometrijami od AX do A2BX4, silikati). Pri vseh strukturah tudi primerjava njihovih lastnosti in možnosti načrtnega spreminjanja le-teh z modifikacijo	Amorphous and crystalline structure of solids, basics of crystallography (periodicity, crystallographic net, unit cell, centering, symmetry, symmetry elements ant their combinations, point groups, space groups). Mechanical, optical, electrical and magnetic properties of solids and their origin. Overview and comparison of the basic structural types of inorganic solids (metals and alloys, closest packing, structures of the elements, ionic structures with stoichiometries from AX to A_2BX_4, silicates). Comparison of structures and properties of solids and possibilities of planned changes of properties by structural modifications. Defects in crystals and their

sestave oz. strukture. Napake v kristalih in njihov vpliv na lastnosti. Teorija difrakcijskih metod (rentgenski žarki, nevtroni, pospešeni elektroni, sipanje na elektronih in atomih, interferenca, kristalne ravnine, indeksi, Braggova enačba, Braggov pogoj, nastanek uklonske slike na monokristalu in polikristaliničnem materialu, recipročna mreža, interpretacija uklonske slike). Uporaba difrakcije (rentgenski praškovni difraktogram, kvalitativna in kvantitativna fazna analiza, indeksiranje, natančno merjenje parametrov osnovne celice). Uporaba elektronske mikroskopije za karakterizacijo trdnin.	influence on properties. Theory of diffraction methods (X-rays, neutrons, electrons, scattering on electrons and atoms, interference, crystal planes, Miller indices, Bragg equation, Bragg condition, diffraction pattern of single crystal and polycrystalline material, reciprocal net, interpretation of the diffraction pattern). Application of diffraction (X-ray powder pattern, qualitative and quantitative phase analysis, indexing, precise determination of unit cell parameters). Application of electron microscopy for the characterization of solids.

Temeljna literatura in viri / Readings:

R. Tilley: Crystals and crystal structures, John Wiley and Sons, Chicester, England 2007, pp. 1-180 of 255.
U. Mueller: Inorganic Structural Chemistry, John Wiley & Sons, pp 36-60, 93-115, 146-183 of 264.
A. Meden, A. Golobič: Zgradba in lastnosti trdnin – vaje, 2011

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Razumevanje osnovnih načel atomske zgradbe trdnih snovi ter povezave med zgradbo in lastnostmi. Poznavanje strukturnih tipov in lastnosti široko uporabljanih trdnin. Poznavanje osnov difrakcijske teorije in elektronske mikroskopije. **Kompetence:** Sposobnost interpretacije atomske zgradbe in na njeni osnovi zmožnost načrtovanja spreminjanja lastnosti danega materiala. Samostojna interpretacija rentgenskega praškovnega difraktograma in izvedba kvalitativne fazne analize. Sposobnost osnovne interpretacije in uporabe rezultatov vrstične in transmisijske elektronske mikroskopije.	*Objectives:* Understanding the basic principles of the atomic structure of solids and the dependence of the properties on the structure. Knowledge of the structure types and properties of commonly used solids. Knowledge of the basic principles of diffraction and electron microscopy. *Competences:* Ability to interpret atomic structure and on this basis predict simple structure-property changes. Interpretation of X-ray powder diffraction pattern and accomplishment of qualitative phase analysis. Basic ability to interpret and use the results of the scanning and transmission electron microscopy.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Poznavanje osnovnih strukturnih tipov trdnin in njihovih glavnih lastnosti. Razumevanje odvisnosti lastnosti trdnin od njihove atomske zgradbe.	<u>Knowledge and Comprehension</u> Knowledge of basic structural types of solids and their main properties. Understanding of the dependence of the properties of solids on their structure.

Osnovno razumevanje rentgenske difrakcije in elektronske mikroskopije.	Basic understanding of X-ray diffraction and electron microscopy.
<u>Uporaba</u> Načrtovanje ciljnega spreminjanja lastnosti trdnin. Identifikacija prisotnih faz v polikristalinični zmesi. Uporaba rezultatov elektronske mikroskopije za karakterizacijo trdnin.	<u>Application</u> The planning of changing of properties of solids. Phase identification of polycrystalline mixtures. The application of results of electron microscopy for the characterisation of solids.
<u>Refleksija</u> Identifikacija problemov, ki so rešljivi z uporabo kristalografskih metod ali elektronske mikroskopije ali kombinacije obojega.	<u>Analysis</u> The identification of problems, which can be solved by the application of crystallographic methods or by electron microscopy or by the combination of both.
<u>Prenosljive spretnosti</u> Samostojno in skupinsko delo za dosego določenega cilja (rezultata). Samostojno iskanje podatkov in virov znanja v literaturi, bazah podatkov in na spletu.	<u>Skill-transference Ability</u> Individual and group work for achieving results. Individual search for data and sources of knowledge in the literature, databases and world wide web.

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

Predavanja, vaje (samostojne in v paru), prostovoljne individualne naloge.	Lectures, tutorials (individual and in pairs) and voluntary individual exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- Pisni izpit (izpit je mogoče opraviti tudi s pozitivno oceno dveh pisnih testov, ki se pišeta sredi in ob koncu semestra). Pogoj za pristop k pisnemu izpitu so opravljene vaje, vključno s pozitivnim kolokvijem iz vaj.	**60**	- Written exam (written exam can be accomplished also by achieving positive grades from two written tests). Positive grade of tutorial work (including with positive colloquium) is necessary before writing the exam.
-Kolokvij iz vaj.	**40**	- Colloquium from tutorial work.
-Testi pripravljenosti na vaje.		- Tests of preparedness for tutorial work.
- Ocena: 6-10 (pozitivno) in 1-5 (negativno)		- Grade: 6-10 (pozitive) and 1-5 (negative)

Reference nosilca / Lecturer's references:

- GOLOBIČ, Amalija*, ŠKAPIN, Srečo D., SUVOROV, Danilo, MEDEN, Anton. Solving structural problems of ceramic materials. *Croatica chemica acta*, ISSN 0011-1643, 2004, vol. 77, no. 3, str.

435-446.
- KASUNIČ, Marta, MEDEN, Anton, ŠKAPIN, Srečo D., SUVOROV, Danilo, **GOLOBIČ, Amalija***. Order-disorder of oxygen anions and vacancies in solid solutions of La2TiO5 and La4Ga2O9. *Acta crystallogr., B Struct. sci***.,** 2009, vol. B65, no. 5, str. 558-566.
- KASUNIČ, Marta, MEDEN, Anton, ŠKAPIN, Srečo D., SUVOROV, Danilo, **GOLOBIČ, Amalija***. Structure of LaTi2Al9O19 and reanalysis of the crystal structure of La3Ti5Al15O37. *Acta crystallogr., B Struct. sci.*, 2011, vol. B67, no. 6, str. 455-460.