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:

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

Dodatna literatura:

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

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Študenti usvojijo temeljno in celostno znanje anorganske kemije, poznavanje določenih anorganskih spojin, njihovih lastnosti in reaktivnosti. Pri tem študent na specifičnih primerih utrjuje in poglablja znanje splošnih kemijskih zakonitosti. **Kompetence:** Študent bo pridobljeno znanje znal uporabiti pri nadaljnjem študiju in v praksi, znal se bo pogovarjati o kemijskih problemih s področja, ki ga obravnava predmet; znal bo povezati znanje splošne in anorganske kemije za reševanje, razlago ali analizo določenega problema. Poznal bo strukturne značilnosti in reaktivnost anorganskih spojin, 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:	BIOTEHNOLOGIJA
Course Title:	BIOTECHNOLOGY

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

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: INSI1

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

Nosilec predmeta / Lecturer: prof. dr. Polona Žnidaršič Plazl / Dr. Polona Žnidaršič Plazl, 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):**
Biotehnologija, njena struktura in interdisciplinarnost. Osnove biotehnologije – osnove mikrobiologije in mikrobne tehnologije. Osnove industrijske mikrobiologije. Osnove genetskega spreminjanja organizmov. Osnove biokatalitskih procesov in bioremediacije. Od mikroorganizma do produkta. Osnove pripravljalnih, produkcijskih in zaključnih procesov. Struktura laboratorijskega, pilotnega in industrijskega procesa. Biotehnološki procesi – Biotehnologija antibiotikov, organskih kislin, aminokislin, imunostimulantov, industrijskih encimov, biogoriva, biotehnologija vina in piva, ekonomika bioprocesov. Bioetika v	Biotechnology its structure and interdisciplinarity. Basic aspects of biotechnology. Basic aspects of microbiology and microbial technology. Basic aspects of industrial microbiology. Basic aspects of genetic engineering. Basic aspects of biocatalysis and bioremediation.From the microorganism to the final product. Basic aspects of *up-stream*, production and *down stream* processing. The structure of laboratory, pilot and industrial process. Biotechnology processes – biotechnology of aerobic processes : antibiotics, organic and amino acids, imunostimulants, industrial enzymes, biofuels. Biotechnology of anaerobic

biotehnologiji.	processes : wine and beer technology. Economics of bioprocessing. Bioetics in biotechnology.

Temeljna literatura in viri / Readings:

- Mitchell, DA, Krieger, N, Berovič, M. Solid-State Fermentation Bioreactors : Fundamentals of Design and Operation. Berlin, Springer, 2006, 442 str. (30%)
- Ratledge C., Kristiansen B., Basic Biotechnology, Cambridge Press, (2001), 342 str. (30%)
- Ignacimurthu S., Biotechnology, Alpha Science Inter. Ltd., Oxford Press (2008), 362. str (20%)
- Enfors S-O., Häggström L.,Bioprocess technology, KTH Press (1996), 356 str. (20%)

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je spoznavanje študentov z interdisciplinarnostjo in zakonitostimi biotehnologije in vloge, mikrobiologije, biokemije in biokemijskega inženirstva v biotehnologiji. Predmet se povezuje s kemijskim inženirstvom, fizikalno kemijo, industrijsko mikrobiologijo, rastlinsko in animalno biotehnologijo. Študentje si pri predmetu pridobijo naslednje specifične kompetence: - sposobnost razumevanja vloge in možnosti aplikaciji inženirskih znanj v biotehnologiji - sposobnost povezovanja inženirskih znanj z znanji mikrobiologije, biokemije, genetike in genskega inženiringa - sposobnost razumevanja delovanja in vloge in mikroorganizmov v biotehnoloških procesih - sposobnost razumevanja strukture delovanja biotehnološkega procesa od laboratorijskih raziskav do industrijskega postopka - Sposobnost razumevanja vloge pripravljalnih procesov, produkcijskih in zaključnih procesov v biotehnologiji	The aim of this course is to introduce students the interdisciplinary and legality of biotechnology in the sence of its applications, microbiology, biochemistry and biochemical engineering. The focus of the study is to learn how to use engineering technology skills and applicatio n in laboratory and industrial practice. The course is linked to chemical engineering, physical chemistry, industrial microbiology, plant and animal biotechnology - Capability and insight in the strathegy and the role of bioreactor design according to the type of microorganism or tissue culture, type of bioprocess and the mode of operation. - Capability and interlinking of bioreactor operation and techniques with chemical and biochemical engineering principles – mass and heat transport processes, fluid dynamics, process rheology and the modes of operation. - Capability of understading the influence of microbial physiology to the bioreactor design and the modes of operation and their influence to the bioprocess development and design. - Capability of understading of pilot and larged scale bioreactors operation.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študentje spoznajo strukturo in interdisciplinarnost področja biotehnologije. Pridobijo osnovna znanja mikrobiologije in mikrobne fiziologije, potrebna za razumevanje poročja in spoznajo pomen in vlogo inženirstva v biotehnoloških postopkih.	Knowledge and Comprehension Students learn about the structure and interdisciplinary field of biotechnology. Acquire basic knowledge of microbiology and microbial physiology needed to understand the area and learn about the importance and role of engineering aspects in biotechnological processes.
Uporaba Študent uporabi znanja in razumevanja o mehanizmih in vlogi mikroorganizmov v biosintezi različnih produktov visokotonažne, rekombinantne in fine biotehnologije, ki jih v praksi nadgradi z inženirskimi znanji.	Application Student use of knowledge and understanding the mechanisms and the role of microorganisms in the biosynthesis of various bulk, recombinant and fine biotechnology products, that in practice upgrade with the engineering skills.
Refleksija Študentje so sposobni samostojno sklepati, definirati problem, kritičnega ovrednotenja skladnosti med teoretičnimi načeli in praktičnim ravnanjem, postavljati zaključke in reševati nekatere zanimive probleme v biotehnologiji.	Analysis Students are able to conclude independently, define a problem, to make a critical evaluation of conformity between theoretical principles and practical behavior, and to formulate independent conclusions and solve some actual biotechnology problems.
Prenosljive spretnosti Študentje pridobijo sposobnost identificiranja in reševanja tehnoloških problemov, sposobni so zbiranja in interpretacije podatkov, kritične analize in sinteze pridobljenih znanj v tehnoloških študijah, povezovanja znanj iz strokovne literature s prakso in prenosom pridobljenih znanj v sorodne tehnologije. Znanje v obliki predavanj, seminarjev in teoretičnih znanj in znanja iz znanstvene literature.	Skill-transference Ability Students gain the ability to identify and solve technological problems, they are capable of collecting and interpreting data, critical analysis and synthesis of acquired knowledge in technological studies, integration of knowledge from the scientific literature with the practice and transmission of the acquired knowledge in related technologies. Knowledge in the form of lectures, seminars and theoretical skills and knowledge from the scientific literature.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji in praktične vaje, strokovne ekskurzije v industriji.	Lectures, seminars, exercises

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit Opravljene vaje so pogoj za pristop k izpitu.	**70%** **30%**	Written and oral exam Accomplished laboratory practice is prerequisite to exam attendance

Reference nosilca / Lecturer's references:

- Wohlgemuth, R., Plazl, I., **Žnidaršič Plazl, P**., Gernaey, K.V., Woodley, J.M. Microscale technology and biocatalytic processes: opportunities and challenges for synthesis. Trends Biotechnol., 2015, 33: 302-314.
- Cvjetko, M., Vorkapić-Furač, J., **Žnidaršič Plazl, P**. Isoamyl acetate synthesis in imidazolium-based ionic liquids using packed bed enzyme microreactor. Process Biochem., 2012, 47: 1344-1350.
- **Žnidaršič Plazl, P**., Plazl, I. Microbioreactors. V: Moo-Young, M. (ur.). Comprehensive Biotechnology, 2nd Ed. Amsterdam [etc.]: Elsevier, 2011, str. 289-301

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 Kemijsko inženirstvo, 1. stopnja	**/**	**3.**	**6.**
USP Chemical Egineering, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: D1KI

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:** **slovenski / Slovenian**
Vaje / Tutorial: **slovenski / Slovenian**

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

Odobrena tema diplomskega dela.

Prerequisites:

Approved topic.

Vsebina:

Diplomsko delo se opravlja iz področja kemijskega inženirstva. Vsebina in naslov se določata v soglasju z izbranim mentorjem. Mentor je lahko učitelj na UL FKKT [t.j. zaposleni na fakulteti na učiteljskem delovnem mestu ali zaposleni na fakulteti na delovnem mestu asistenta, ki ima učiteljski naziv (docent, izredni ali redni profesor) ali nosilec predmeta na študijskem programu 1. ali 2. stopnje UL FKKT, ki ni zaposlen na fakulteti]. Mentor je praviloma učitelj na programu, ki ga je študent vpisal.

Content (Syllabus outline):

Diploma work is performed in one of the areas of chemical engineering. 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:

Monografije in članki, ki so povezani z dogovorjeno tematiko diplomskega dela.

Books and journal articles related to the research topic.

Cilji in kompetence:	**Objectives and Competences:**
Dokončno oblikovanje pričakovanega lika diplomanta. Študent bodo ob izdelavi diplomske naloge pokazal sposobnosti iskanja in zaznavanja problemov kemijskega inženirstva in znal poiskati rešitev za tak problem. Pri delu bodo pokazal, da je pridobil 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 obravnavanja problema v praksi, • sposobnosti iskanja rešitev 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 chemical engineer.
Refleksija Povezovanje vseh pridobljenih teoretičnih znanj z reševanjem problemov na področju kemijskega inženirstva ter kritični pogled na uporabnost teh znanj.	Analysis Connection of all acquired theoretical knowledge to solve problems in the chemical engineering area. Critical distance to acquired knowledge.
Prenosljive spretnosti Pri delu bo diplomant pridobil znanja o metodah reševanja problemov, o načinu prezentacije teh znanj v pisani in govorjeni obliki povezani z ostalimi metodami posredovanja raziskav ugotovitev itd.	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:**
Individualno delo mentorja in samostojno študijsko in raziskovalno delo.	Individual work with mentor and independent self-study and research work.

Delež (v %) /

Načini ocenjevanja:	Weight (in %)	**Assessment:**
Ocenjuje se diplomsko delo in zagovor diplomskega dela pred komisijo, ki jo sestavljajo predsednik, mentor in en član.		Diploma work and its presentation are graded separately by a three-member commission (chairman, mentor, additional member).

Reference nosilca / Lecturer's references:

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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:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Kinematika: premo enakomerno in pospešeno gibanje točkastega telesa, gibanje v prostoru. **Dinamika:** sila in masa. Newtonovi zakoni, izrek o gibanju težišča, izrek o gibalni količini, sila curka, izrek o kinetični energiji, delo, potencialna energija, prožnost, prožnostna energija, vrtenje togega telesa okoli nepremične osi, navor, Newtonov zakon pri vrtenju, izrek o vrtilni količini. **Mehanika tekočin:** hidrostatika, hidrostatični	**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:**
<u>Znanje in razumevanje</u> 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.	<u>Knowledge and Comprehension</u> 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.
<u>Uporaba</u> 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,	<u>Application</u> 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
<u>Refleksija</u> Pridobljeno znanje fizikalnih osnov bo študentu omogočilo kritično ovrednotiti rezultate laboratorijskih meritev in poglobljeno razumevanje predpisanih postopkov pri izvajanju meritev.	<u>Analysis</u> 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	Skill-transference Ability
Sposobnost samostojnega spremljanja novih spoznanj in literature s področja laboratorijske tehnike. Razumevanje fizikalnih meritev in sposobnost njihovega ovrednotenja. Kritičen odnos do standardov kakovosti.	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 -izpita iz teorije -izpita iz vaj Ocene 6-10 pozitivno.	 **50 %** **50 %**	Written exam problem solving. Final score: theory: 50%, problem solving: 50%. 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).

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

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN115

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

Nosilec predmeta / Lecturer: prof. dr. Matevž Pompe /
Dr. Matevž Pompe, 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 parametri analiznega procesa: izbira metode, priprava vzorca, občutljivost, selektivnost, meja zaznave. **Statistika in vrednotenje rezultatov**: naključne in sistematične napake, statistični parametri in obdelava podatkov, ovrednotenje rezultatov, načrtovanje ekperimetov. **Ravtotežja v analizni kemiji** **Pregled analiznih metod za določanje makro komponent.** Prednosti in slabosti teh metod. **Pregled instrumentalnih metod za identifikacijo in kvantitativno določanje snovi**. Interakcija elektromagnetnega valovanja s snovjo. Principi tehnik in	**Basic concepts and parameters of the analytical process:** choice of methods, sample preparation, sensitivity, selectivity, detection limit. **Statistics and evaluation of the results:** random and systematic errors, statistical parameters and data processing, evaluation of the results, experimental design. **Equilibrium in analytical chemistry** **Overview of the analytical methods for determination of macro components:** advantages and disadvantages of the methods. **Overview of the instrumental methods for the identification and quantification of substances.**

uporabnost za analitiko. Molekulska absorpcijska spektrometrija: osnovne zakonitosti, značilnosti in uporaba. Atomska absorpcijska in emisijska spektrometrija: osnovni principi, karakteristike metod in značilne uporabe v analitiki anorganskih spojin. IR spektrometrija, značilnosti, priprava vzorcev za merjenje. Rentgenska fluorescenca: princip in uporaba **Elektrokemijske metode.** Potenciometrija, principi, indikatorske in referenčne elektrode, steklena elektoda in merjenje pH, uporaba za potenciometrično indikacijo pri različnih titracijah. Elektrogravimetrija, voltametrija. Kontinuirno spremljanje koncentracij snovi. **Uporaba predstavljenih metod za kvantitativno določanje komponent v realnih vzorcih.** Priprava vzorcev, raztapljanje, shranjevanje. **Separacijske metode**. Ekstrakcija tekoče-tekoče. Ekstrakcija na trdno fazo. Osnove kromatografije. Plinska in tekočinska kromatografija. Zmožnosti metod in uporaba za določanje organskih snovi v realnih vzorcih. Masna spektrometrija. Osnove ionizacije. Tipi analizatorjev. Uporaba MS za identifikacijo in kvantifikacijo. ICPMS in uporaba. Izbira metode in kritično ovrednotenje rezultatov analiz. Osnove validacije. NMR osnove in uporabnost.	The interaction of electromagnetic radiation with matter. Principles of the techniques and application in analytical chemistry. Molecular absorption spectrometry: basic principles, characteristics and applications. Atomic absorption and emission spectrometry: basic principles, method characteristics and applications in analysis of inorganic matter. IR spectrometry, characteristics, sample preparation. X-ray fluorescence spectrometry: principles and applications. **Electrochemical methods.** Potentiometry, principles, indicator and reference electrodes, glass electrode and measurements of pH, application in various potentiometric titrations. Electrogravimetry, voltammetry. Continuous monitoring of the concentration of the substance. **The use of the presented methods for the determination of components in real samples.** Sample preparation, dissolution, storage. **Separation methods.** Liquid-liquid extraction. Solid-phase extraction. Basic principle of chromatography. Gas and liquid chromatography. The ability of the methods and the usage for the determination of the organic compounds in the real samples. Mass spectrometry. Basics of the ionisation. Mass analyzers. Application of MS for identification and quantification. ICP/MS and usage Selection of the methods and critical evaluation of the analytical results. Basics of the method validation. Basics and applications of NMR.

Temeljna literatura in viri / Readings:

- D.A.Skoog, F.J.Holler, T.A.Nieman, Principles of Instrumental analysis, 5th Saunders College Publishing, 1998,Philadelphia, str. 700 (45%)

Cilji in kompetence:	**Objectives and Competences:**
Slušatelji v okviru predmeta osvojijo temeljne principe kemijske analize. Pridobijo znanja potrebna za razumevanje in izvedbo posameznih kemijskih in osnovnih instrumentalnih tehnik. Spoznajo pristope k izvedbi analiz. Specifične kompetence: zmožnost izbire posamezne analizne metode za reševanje enostavnih analiznih problemov.	Student in this course acquire basic knowledge of chemical analysis. Gains knowledge needed to understand and implement individual basic chemical and instrumental techniques. Learns about the approaches of the analyses. Specific skills: ability to choose specific analytical methods for solving simple analytical problems.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študentje spoznajo instrumentalne metode in primernost njihove uporabe za reševanje konkretnih analiznih problemov. Znajo kritično uporabiti rezultate.	<u>Knowledge and Comprehension</u> Students learn instrumental methods and their application to solving specific analytical problems. Student gain knowledge for critical evaluation of the results.
<u>Uporaba</u> Študent je sposoben izbrati analizno metodo za rešitev problema. Razume dobljene rezultate.	<u>Application</u> Students are capable of selection of analytical method for solving particular analytical problem. Students understand obtained results.
<u>Refleksija</u> Spozna prednosti in slabosti različnih instrumentalnih metod in jih zna kritično izbrati.	<u>Analysis</u> Students learn advantages and disadvantages of various instrumental methods and are capable of their critical selection.
<u>Prenosljive spretnosti</u> Študent bo poznal in razumel podatke, dobljene z instrumentalnimi metodami	<u>Skill-transference Ability</u> Students will know and understand the data obtained by instrumental methods.

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Pisni (nadomestita ga lahko dva pozitivno ocenjena kolokvija) in ustni izpit.		Written (can be substituted by two positively graded colloquium) and oral exam.

Reference nosilca / Lecturer's references:

1. 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.
2. 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.
3. 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:	KEMIJSKA IN PROCESNA VARNOST
Course Title:	CHEMICAL AND PROCESS SAFETY

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN118

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: doc. dr. Barbara Novosel / Dr. Barbara Novosel, 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):
Prepoznavanje, razumevanje delovanja in obvladovanje nevarnih kemikalij (eksplozivne, vnetljive, oksidativne, strupene, jedke in okolju nevarne kemikalije ter plini). Pregled evropskega sistema obvladovanja tveganja pri ravnanju s kemikalijami - REACH. Varnost pri delu v laboratoriju, kemijskih in drugih procesnih industrijah. Kompleksnost delovanja industrijskega procesa, tehnološki režim in standardni proizvodni postopki, ustreznega vzdrževanja posameznih naprav in celotnega sistema. Ocena verjetnost za nastanek izrednih situacij v kemijskih procesih ter preprečevanje in ukrepanje.	Knowledge on recognition, understanding and management of hazardous chemicals (explosive, flammable, oxidizing, toxic, corrosive and environmentally hazardous chemicals and gases). Fundamentals of European system of risk management in handling the chemicals - REACH. Safety, Health and Loss Prevention at work in a laboratory, chemical and other process industries. The complexity of the operation of industrial processes, technological regime and the standard manufacturing procedures, proper maintenance of individual devices and the entire system. Estimate the probability of accidents in chemical processes, prevention and response.

Identifikacija potencialnih nevarnosti v kemijskem procesu, začetni dogodki, širjenje izrednih dogodkov, zmanjševanje posledic izrednih dogodkov. Analiza industrijskih procesov in priprava ocen tveganja. Zajemanje pomembnih in kritičnih parametrov ter pogojev procesa, ki vplivajo na njegovo varnost, možni scenariji izrednih dogodkov. Kvalitativna in kvantitativna ocena tveganja. Vaje: seznanjanje z možnim tveganjem v kemijskem procesu (podatki o nevarnih kemikalijah, vnetljive trdne snovi), določevanje snovnih lastnosti snovi (plamenišče, tališče), prašne eksplozije (določevanje minimalne vžigne energije), plini (nevarnosti, preprečevanje, označevanje tlačnih posod), možnosti in načini preprečevanja nastanka izrednih razmer.	Identification of of potential risks in the chemical process, initiating events, the spread of incidents, reducing the consequences of exceptional events. Analysis of industrial processes and the preparation of risk assessments. Capture important and critical process parameters and conditions that affect the security of the possible scenarios of emergencies. Qualitative and quantitative risk assessment. Exercises: Students get knowledge of the risk in chemical process (information about hazardous chemicals, flammable solids), determination of material properties (flash point, melting point), dust explosion (determination of minimum ignition energy), gas (hazard prevention, identification of pressure vessels), possibilities and ways of preventing the occurrence of an emergency.

Temeljna literatura in viri / Readings:

- Burke R.: Hazardous materials chemistry for emergency responders, 3rd Ed. CRC Press, Boka Raton 2013, 527 str. (30%)
- Brauer, R., L.: Safety and health for engineers, 3rd Ed., Wiley, cop. Hoboken (New Jersey), 2016 765 str. (30%)
- Marshall V., Ruhemann S., Fundamentals of Process Safety, ICHEME, Warwickshire 2001 (20%)
- Crowl D.A., Louvar J.F., Chemical Process Safety, 2nd Ed., Prentice Hall PTR, New Jersey 2002 (20%)

Cilji in kompetence:	**Objectives and Competences:**
Pri predmetu se študenti seznanijo z zagotavljanjem varnosti pri delu z različnimi kemikalijami v laboratoriju in v kemijskih ter procesnih industrijah. Spoznajo potrebo po natančnem poznavanju vseh lastnosti kemikalij, ki jih pri svojem delu uporabljajo. Pridobljeno znanje omogoča razumevanje in presojanje nevarnosti oziroma stopnje tveganja ter določitev ukrepov za varno in zdravo delo. Študentje spoznajo, da je za varno delo v industriji osnovni pogoj natančno poznavanje vseh faz procesa in podrobna analiza delovanja na osnovi katere se izvede ocene tveganja. Spoznajo, da je varnost procesa pogojena z mnogo dejavniki in da je za njegovo varno obratovanje potrebno tako	Students get knowledge to ensuring safety, health and loss prevention in chemical processes. Learn about the need of precise knowledge of the characteristics of chemicals they use at work. The knowledge enables the students to understand and assess the level of danger or risk and to establish measures to ensure the safe handling of hazardous chemicals. Students learn that basic conditions for safe work in industry are exact knowledge of all phases of the process and the importance of a risk assessment. Students learn that process safety depends on many factors. For safe operation is necessary so optimize the performance of individual part of the process operation as well as the system as a whole.

optimalno delovanje posameznih procesnih operacij kot tudi usklajeno delovanje sistema kot celote. Študentje se pri predmetu usposobijo za sistematičen pregled kemijskih in drugih sorodnih procesov, zaznavanje potencialnih kritičnih mest, priprave ocene tveganja in ukrepov za zmanjšanje tveganja.	Students are trained for a systematic review of chemical and other related processes, identify potential critical points, preparation of risk assessment and risk reduction measures.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študentje se pri predmetu usposobijo za sistematičen pregled nevarnosti pri uporabi nevarnih kemikalij ter pri delu v kemijskih in sorodnih procesih, za zaznavanje potencialnih kritičnih mest, pripravo ocene tveganja in ukrepov za zmanjšanje tveganja.	Knowledge and Comprehension The subject makes students capable of a systematic review of the risks of using dangerous chemicals and work in the chemical and related processes for detecting potential critical points, risk assessment and risk reduction measures.
Uporaba Delo z nevarnimi kemikalijami. Vodenje in nadzor kemijskih procesov. Ocenjevanje tveganja kemijskih procesov. Analiza nazgod in določevanje ukrepov za preprečitev nezgod.	Application Work with hazardous chemicals. Management and control of chemical processes. Risk assessment of chemical processes. Accident analysis and determination of measures to prevent accidents.
Refleksija Študenta se usmeri v podrobnejši pregled lastnosti posamezne kemikalije z namenom, da ugotovi nevarnosti snovi za človeka in okolje. Na osnovi spoznanj mora določiti varnostne ukrepe za zmanjšanje ali celo eliminacijo tveganja pri rabi kemikalije. Glede na veljavno SI zakonodajo so podana znanja osnova za opravljanje izpita za svetovalce za kemikalije v različnih podjetjih, kakor tudi temelji za delo v carinski, komercialni ali inšpektorski službi.	Analysis A student will be directed to a more detailed examination of the properties of each chemical in order to identify the hazards of the substance for humans and the environment. Based on the findings should establish the security measures for the reduction or even elimination of risk in the use of chemicals. According to the current SI legislation knowledge is the basis for the exam for counselors of chemicals in various companies, as well as it is basis for the job of customs, commerce or in the field of inspections.
Prenosljive spretnosti Sistematičen, analitičen pristop do reševanja problema, več razumevanja in upoštevanja varnostne kulture.	Skill-transference Ability Systematic, analytical approach to problem solving, more understanding and taking into account safety culture.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- Predavanja, - seminarji, - praktične vaje	- lectures, - Seminars, - Practical exercises

Delež (v %) /

Načini ocenjevanja:	Weight (in %)	**Assessment:**
Opravljene vaje, pisni izpit (računske naloge), ustni izpit (15 min), ocenjevalna lestvica skladna s Statutom UL.		
Vaje. 20%	**20 %**	Laboratory practice
Pisni izpit. 50%	**40 %**	Written exam
Ustni izpit. 50%	**40 %**	Oral exam

Reference nosilca / Lecturer's references:

- SLABAJNA, Dominika, **NOVOSEL, Barbara**. Smernica za zagotavljanje varnosti in zdravja v kemijskih laboratorijih : projekt Kemijska varnost 3. Ljubljana: Urad RS za kemikalije: Univ. v Ljubljani, Fak. za kemijo in kemijsko tehnologijo, 2010. 48 str., ilustr. http://www.fkkt.uni-lj.si/si/?2416. [COBISS.SI-ID 34765317]
- **NOVOSEL, Barbara**, MARINŠEK, Marjan. Računska obravnava kemijskih procesov : zbirka nalog. V Ljubljani: Fakulteta za kemijo in kemijsko tehnologijo, 2003. 132 str., ilustr. ISBN 961-6286-56-0. [COBISS.SI-ID 125977600]

NOVOSEL, Barbara. Ugotavljanje kritičnih mest v kemijski industriji in zmanjševanje tveganja nezgod. V: BRVAR, Miran (ur.). Kemijske nesreče na delovnem mestu : zbornik prispevkov. Ljubljana: Slovensko zdravniško društvo, Sekcija za klinično toksikologijo, 2013, str. 78-83. [COBISS.SI-ID 1654319]

- MAČEK, Jadran, **NOVOSEL, Barbara**, MARINŠEK, Marjan. Anorganska kemijska tehnologija, Navodila za vaje za 3. letnik UN ŠP Kemijsko inženirstvo. Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo, Katedra za anorg. kem. tehnologijo in materiale, 2001/2002. III, 61 str., tabele. [COBISS.SI-ID 24156165]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	KEMIJSKA TERMODINAMIKA
Course Title:	CHEMICAL THERMODYNAMICS

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN114

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 Lah / Dr. Jurij Lah, 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:

Osnovni pojmi

Sistem, lastnosti sistema, stanje sistema, funkcije stanja in funkcije poti, ravnotežje. Enačbe stanja: Plinski zakoni, enačba stanja idealnega plina, van der Waalsova enačba, virialna enačba, enačba stanja za plinske zmesi. Kritični pojavi.

Zakoni termodinamike

I. zakon termodinamike: Energija, toplota, delo. Reverzibilni in ireverzibilni procesi. Entalpija. Termokemija in termokemijske enačbe.

II. zakon termodinamike: Toplotni stroji: izkoristek, Carnotov krožni proces. Entropija.

Content (Syllabus outline):

Basic concepts

System and its properties, system state, state functions and path functions, equilibrium. Equations of state: Gas laws, equation of state for ideal gas, van der Waals equation, virial equation, equation of state for gas mixtures. Critical phenomena.

Laws of thermodynamics

I. Law of thermodynamics: energy, heat, work. Reversible and irreversible processes. Enthalpy. Thermochemistry and thermochemical equations.

II. Law of Thermodynamics: Heat engines: efficiency, Carnot cycle. Entropy. Changes in

Spremembe entropije pri reverzibilnih in ireverzibilnih procesih. Ravnotežni pogoji za zaprte sisteme: prosta energija, termodinamski potenciali, odvisnost termodinamskih funkcij od tlaka in temperature. III. zakon termodinamike.	entropy in reversible and irreversible processes. Equilibrium conditions for closed systems: free energy, thermodynamic potentials, the dependence of thermodynamic functions on pressure and temperature. III. Law of thermodynamics.
Odprti sistemi Faze, komponente, prostostne stopnje. Fazno pravilo. Clapeyronova in Clausius-Clapeyronova enačba. Fazni diagrami.	**Open systems** Phase, components, degrees of freedom. Phase rule. Clapeyron and Clausius-Clapeyron equation. Phase diagrams.
Raztopine Idealne in neidealne raztopine, Raoultov zakon, Henryjev zakon. Parcialne molske količine, kemijski potencial. Fugativnost, aktivnost in koeficient aktivnosti. Standardna stanja. Termodinamika mešanja. Koligativne lastnosti: Osmozni tlak, znižanje zmrzišča, zvišanje vrelišča.	**Solutions** Ideal and non-ideal solutions, Raoult's law , Henry's law. Partial molar quantities, chemical potential. Fugacity, activity and activity coefficient. Standard states. Thermodynamics of mixing. Colligative properties: osmotic pressure, lowering the freezing point, boiling point increase.
Kemijsko ravnotežje Konstanta ravnotežja. Homogeno ravnotežje v plinasti in tekoči fazi. Heterogena ravnotežja. Le Chatelierov princip.	**Chemical equilibrium** Equilibrium constant. Homogeneous equilibrium in gaseous and liquid phase. Heterogeneous equilibria. Le Chatelier principle

Temeljna literatura in viri / Readings:

- A. Jamnik, Fizikalna kemija (1. izdaja), založba FKKT (2013) (80%), ISBN: 978-961-6756-39-6 (1. zvezek) (20%), ISBN: 978-961-6756-40-2 (2. zvezek).
- Physical Chemistry, P. Atkins in J. de Paula, Oxford University Press, 8. Izdaja (2006), 1050 str., (30%), ISBN 9780198700722.
- Physical Chemistry, W. Moore, Prentice-Hall, New Jersey, 5. Izdaja (1972), str. 1-570, (50%), ISBN 0582442346.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je spoznavanje povezave med fizikalnimi in kemijskimi pojavi ter med fizikalnimi in kemijskimi lastnostmi snovi. Študent se seznani s temeljnimi fizikalno kemijskimi količinami, s katerimi popisujemo stanje sistemov, ter s povezavo med njimi. Spozna splošne zakonitosti pri opisu različnih problemov iz naravoslovja in fizikalno-matematične metode za njihovo reševanje. Študenti si pri predmetu pridobijo naslednje specifične kompetence:	The objective of this subject is to study the relation between physical and chemical phenomena and between physical and chemical properties of the matter. Students get acquainted with the fundamental physico-chemical quantities with which we describe the state of the systems, and the relation between them. Students learn about general laws useful in describing various problems in science and get acquainted with physico-mathematical methods to solve them.

- razumevanje termodinamskih zakonov in termodinamskih funkcij stanja ter njihova uporaba pri kemijskih reakcijah in fizikalnih procesih - uporaba kriterijev za napoved spontanosti poljubnih procesov pri različnih konstantnih pogojih - uporaba različnih načinov, s katerimi vplivamo na kemijsko ravnotežje - sistematičnost pristopa pri reševanju teorijskih problemov in računskih nalog	Students of the course gain the following specific competencies: - Understanding the thermodynamic laws and thermodynamic state functions and their use in chemical reactions and physical processes - Use of criteria for predicting the spontaneity of processes at different constant conditions - Use various ways for influencing the chemical equilibrium. - A systematic approach in solving theoretical and numerical problems.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Poznavanje osnovnih fizikalno-kemijskih količin kot so notranja energija, entalpija, prosta energija in entropija. Poznavanje osnovnih zakonov termodinamike. Razumevanje pojmov obrnljivosti (reverzibilnosti) in neobrnljivosti (ireverzibilnosti) procesov. 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 basic physico-chemical quantities such as internal energy, enthalpy, free energy and entropy. Knowledge of the basic laws of thermodynamics. Understanding the concepts of reversible and irreversible processes. Knowing the criteria for spontaneous chemical reactions and chemical equilibrium. Understanding the difference between thermodynamics (spontaneity) and kinetics (rate) of a chemical reaction.
Uporaba Uporaba tabeliranih fizikalno-kemijskih podatkov (standardne tvorbene entalpije, standardne entropije, toplote faznih prehodov, toplotne kapacitete) pri določanju termodinamike kemijskih reakcij pri različnih pogojih.	Application Using tabulated physico-chemical data (standard enthalpy of formation, standard entropy, heat of phase transitions, heat capacity) in determining the thermodynamics of chemical reactions under different conditions.
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. Kritična presoja pri izbiri kemijske reakcije za pridobivanje določenega produkta.	Analysis The students acquire the feeling for physico-mathematical way of thinking and for cognition about general physico-mathematical methods for the solution of various problems in natural science. Deeper understanding of the significance of abstract physico-chemical principles and properties. A critical assessment of the choice of chemical reactions for the production of a specific product.

Prenosljive spretnosti Uporaba splošnih naravoslovnih zakonitosti pri študiju inženirskih vsebin, ki so zajete pri drugih predmetih. Uporaba domače in tuje literature.	Skill-transference Ability The use of general natural laws in studying chemical engineering, which are included in other subjects. The use of domestic and foreign literature.

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

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

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:	KEMIJSKO INŽENIRSKA TERMODINAMIKA
Course Title:	CHEMICAL ENGINEERING THERMODYNAMICS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemijsko inženirstvo, 1. stopnja	/	3.	5.
USP Chemical Egineering, 1st Cycle	/	3rd	5th

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	IN132

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

Nosilec predmeta / Lecturer:	Izr. prof. dr. Aleš Podgornik / Dr. Aleš Podgornik, 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: Pomen kemijsko inženirske termodinamike v praksi kemijskega inženirstva, tako na področju separacijskih procesov, načrtovanja reaktorjev, področju produktnega inženirstva, kot tudi uporabi termodinamike pri reševanju varnostnih in okoljskih problemov. Ocena in napoved termofizikalnih lastnosti realnih substanc: a) čistih komponent: gostota, viskoznost, parni tlak, toplotna kapaciteta, izparilna entalpija, toplotna prevodnost, površinska napetost; b) mešanic. Fazna ravnotežja (dvofazna, večfazna in	The significance of chemical engineering thermodynamics in the area of separation processes, design of reactors, product engineering, as well as the use of thermodynamics in solving safety and environmental problems. Estimation of thermo-physical characteristics of substances: pure components (density, viscosity, partial pressure, heat capacity, heat of evaporation, thermal conductivity, surface tension) and mixtures. Knowledge of phase equilibrium (two-phase, multi-phase and multi-component): VLE, GLE, SLE, chemical equilibrium, combined chemical and phase equilibrium; modern computational

večkomponentna): VLE, GLE, SLE, kemijsko ravnotežje, kombinirano kemijsko in fazno ravnotežje; Moderne računske metode: korelacijski modeli kot g^E modeli oz. modeli aktivnostnih koeficientov, enačbe stanja za realne snovne sisteme in napovedni modeli kot metode prispevkov grup (UNIFAC, PSRK,..), modeli za izbor ustreznega topila, teoretični modeli. Procesni simulatorji. Predstavitev nekaj eksperimentalnih metod za določanje termofizikalnih lastnosti čistih substanc in mešanic. Praktični in računski primeri ravnotežij. Procesna termodinamika: Zakon o ohranitvi mase, energije in entropijska bilanca. Obravnavanje procesov in naprav, ki omogočijo pretvorbo energije iz ene oblike v drugo: turbina, toplotni stroji, kompresorji, toplotne črpalke, hladilni stroji. Izračun stopnje učinkovitosti. Pseudo-krožni procesi. Uporaba toplotnih črpalk v kemijski industriji. Uporaba p,h-diagramov in t,s-diagramov, primerjava realnega sistema (nekaj realnih primerov) z idealnim procesom, analiza, ocena stopnje učinkovitosti. Termodinamski uščip. Ovrednotenje procesnih alternativ.	methods: correlation models, g^E models, models of activity coefficients, state equations for real systems, models for the selection of appropriate solvents, theoretical models; Process simulators; Practical and computational examples of equilibrium. Process thermodynamics comprises mass, energy and entropy balances. Processes and equipment for transformation of one energy form into another are discussed such as turbines, heat pumps, compressors, refrigeration systems. Calculation of efficiency. Application of heat balances in chemical industry. Usage of p,h-diagrams and t,s-diagrams, comparison of ideal and real processes, analysis, estimation of efficiency. Evaluation of process alternatives.

Temeljna literatura in viri / Readings:

- I. S. Sandler, Chemical, Biochemical, and Engineering Thermodynamics, Wiley, 4th Edition, 2006, 945 strani (45 %).

Dopolnilna literatura.

- B. E. Poling, J. M. Prausnitz, J. P. O'Connel, The Properties of Gases and Liquids, McGraw Hill, 5th Edition, 2001.
- H. D. Baehr, Thermodynamik, Springer Verlag, 11. Auflage, 2002, 644 strani.

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

Predmet predstavlja osnovna znanja, ki so potrebna slušateljem kemijskega inženirstva, saj le z razumevanjem principov kemijsko inženirske termodinamike, poznavanjem ustreznih metod in orodij lahko pristopijo k načrtovanju naprav, procesov in produktov. Na realnih problemih bodo študentje pridobili sposobnost analize problema in sinteze znanj v povezavi s fluidno mehaniko, separacijskimi procesi, načrtovanjem reaktorjev, kot tudi biokemijskim inženirstvom.	Course provides understanding of fundamental principles of chemical engineering thermodynamics necessary for all chemical engineers since only understanding of suitable methods and tools enables design of equipment, processes and products. On the basis of actual problems, students will acquire the abilities to analyze problems and relate their knowledge with fluid dynamics, separation processes, reactor design as well as biochemical engineering.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent po osvojitvi pojmov, teorij in modelov pridobi razumevanje termodinamskega snovnega obnašanja, sposobnost matematične formulacije, ter ob reševanju konkretnih primerov realnih snovnih sistemov pridobi osnovno razumevanje procesno relevantnih povezav v kemijskem inženirstvu.	Knowledge and Comprehension Students acquire basics, theory and models necessary to understand thermodynamic behaviour, capability of mathematical formulation and by solving specific real cases acquire understanding of relevant relations within chemical engineering.
Uporaba Pridobljena znanja bodo študentom omogočila samostojen pristop k reševanju kemijsko inženirskih problemov kot načrtovanje procesa, optmizacija procesa, ocena možnih vplivov kemikalij na okolje ob raznih dogodkih v kemijski industriji, analizo biokemijskih procesov, načrtovanju produktov, identificiranju kemikalije ali mešanice, ki nudi lastnosti, potrebne za določeno aplikacijo in pd.	Application Acquired knowledge enables students an advanced approach for solving chemical engineering problems such as process design, process optimisation, influence of chemicals on environment, analysis of biochemical processes, product design, identification of compounds and their mixtures needed for particular applications, etc.
Refleksija Študent je sposoben razumevanja osnovnih principov kemijskega inženirstva, sposoben je analizirati in kritično ovrednotiti posamezne izbrane termodinamske modele pri reševanju aktualnih inženirskih problemov ter uporabiti pridobljeno znanje na vseh področjih kemijskega inženirstva.	Analysis Student is capable to understand basic principles of chemical engineering, to analyse and critically evaluate different thermodynamic models for their application of engineering challenges as in all areas of chemical engineering.
Prenosljive spretnosti Sposobnost uporabe literature, zbiranja in interpretacije podatkov, sposobnost identifikacije, analize in reševanja inženirskih problemov. Kritična presoja rezultatov ter	Skill-transference Ability Ability to use literature and proper data interpretation, identification, analysis and solving of engineering problems. Critical evaluation of results and presentation of the

sposobnost predstavitve postopka reševanja problema v pisni in ustni obliki.	problem in written and oral form.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji oz. projektna naloga.	Lectures, seminars or project work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit.	**80%**	Written and oral exam
Seminarska naloga.	**20%**	Seminar (project work).

Reference nosilca / Lecturer's references:

Zacharis, Constantinos K., Kalaitzantonakis, Eftichios A., Podgornik, Aleš, Theodoridis, Georgios A. Sequential injection affinity chromatography utilizing an albumin immobilized monolithic column to study drug-protein interactions. *J. chromatogr., A*, 2007, issue 1, vol. 1144, str. 126-134. [COBISS.SI-ID 3420024]

Lendero Krajnc, Nika, Smrekar, Franc, Štrancar, Aleš, Podgornik, Aleš. Adsorption behavior of large plasmids on the anion-exchange methacrylate monolithic columns. *J. chromatogr., A*, 2011, vol. 1218, iss. 17, str. 2413-2424, doi: 10.1016/j.chroma.2010.12.058.

Bednar, Ingeborg, Tscheließnig, Rupert, Berger, Eva, Podgornik, Aleš, Jungbauer, Alois. Surface energies of hydrophobic interaction chromatography media by inverse liquid chromatography. *J. chromatogr., A*, 2012, vol. 1220, str. 115-121, doi: 10.1016/j.chroma.2011.11.001.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	KEMIJSKO INŽENIRSTVO I
Course Title:	CHEMICAL ENGINEERING I

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN111

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. 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:

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

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Uvod: Pomen kemijskega inženirstva v svetu tehnike, znanosti in gospodarstva. Domena in smeri razvoja kemijskega inženirstva. Področja aktivnosti kemijskega inženirja.

Osnovna matematična orodja: procesne spremenljivke, predstavitev in analiza eksperimentalnih podatkov, metoda najmanjših kvadratov. Računski primeri.

Koncept kvantitativnega reševanja kemijsko-inženirskih problemov: definicija sistema, nastavitev problema, matematični zapis, reševanje, verifikacija. Računski primeri.

Splošne masne bilance stacionarnih in nestacionarnih sistemov. Računski primeri z

Content (Syllabus outline):

Introduction (significance of chemical engineering in the world of technology, science and economy, development trends in chemical engineering, chemical engineer's line of activity). Process variables, presentation and analysis of experimental data, the least square method, calculus examples. The concept of quantitative solving of chemical-engineering problems (definition of the system, determination of the problem, mathematical formulation, solving and verification, calculus examples). General material balances of steady and unsteady state systems (calculus examples with consideration of the phase equilibrium, chemical reaction and mass transport). The

upoštevanjem faznega ravnotežja, kemijske reakcije in prenosa snovi. Proces in procesna shema. Osnovne procesne spremenljivke. Osnovne faze kemijskega procesa: priprava, kemijska pretvorba, izolacija in čiščenje produkta. Šaržni, kontinuirni in polšaržni procesi, povratni tok (recikel). Primeri sinteze posameznih postopkov v proces. Računski primeri.	process and the processing scheme (the basic processing variables, the basic phases of chemical process: preparation, chemical conversion, isolation and purification of product, batch, continuous and semi batch processes, recurring or recycle flow). Examples of synthesis of individual procedures into the process (calculus examples).

Temeljna literatura in viri / Readings:

- R.M.Felder and R.W.Rousseau: Elementary Principles of Chemical Processes. John Wiley & Sons, 2005, 675 str. (30%)

Cilji in kompetence:	**Objectives and Competences:**
Cilji predmeta: študent osvoji osnovna kemijsko inženirska znanja potrebna pri nadaljevanju študija in pozneje pri opravljanju poklica, zmožnost za osnovno analizo, sintezo in kvantitativno vrednotenje enostavnih kemijsko tehnoloških procesov. Predmetno specifične kompetence: - razume značilnosti kemijsko inženirske stroke - zna identificarti problem, ga rešiti in predstaviti v kvantitativni obliki - pri praktičnih reševanju primerov zna uporabiti snovne in energijske bilance, matematična orodja in osnovne kemijske in fizilkalne zakone- - zna analizirati proces in procesno shemo - razvija interes za obravnavanje inženirskih problemov.	Understanding of characteristics in the chemical engineering field. Ability to identify the problem, solve it and to interpret it in quantitative form. The knowledge of using material and energy balances, mathematical tools and basic chemical and physics laws to solve practical problems. Ability to analyze processes and the processing schemes. To develop an interest in engineering problem proceedings.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje 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 principov kemijskega inženirstva v kemijski procesni tehniki.	Knowledge and Comprehension 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 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 na dodiplomski zahtevnostni stopnji.	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 Razvita sposobnost identifikacije in reševanja problemov, kritičnega razmišljanja in logičnega sklepanja. Sposobnost uporabe literature, zbiranja in interpretacije podatkov in njihove kritične evalvacije ter sposobnost predstavitve rezultatov reševanja problema oziroma poročanja v pisni in ustni obliki.	Skill-transference Ability Ability of identifying and solving problems, critical thinking and deduction; Ability of gathering, selecting and interpreting data and their critical evaluation; Ability of comprehensive results presentation.

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit. Opravljena seminarska naloga (oddan pisni izdelek in ustna predstavitev) je pogoj za pristop k izpitu.	**100 %**	Written exam. Accomplished project work (written report and oral presentation) is a prerequisite to exam attendance.

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:	KEMIJSKO INŽENIRSTVO II
Course Title:	CHEMICAL ENGINEERING II

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN119

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. 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):**
Temeljna vsebinska področja predmeta so: - energijske bilance: reakcijski in separacijski procesi; entalpijske spremembe; - numerično reševanje navadnih diferencialnih enačb: analitična metoda, Eulerjeva metoda, Rungejeva trapezna metoda, Runge-Kutta-klasična metoda četrtega reda, sistem navadnih diferencialnih enačb; - numerično reševanje parcialnih diferencialnih enačb: eksplicitna in implicitna metoda končnih razlik, analitična in numerična rešitev Laplaceove enačbe; - zapis in reševanje ohranitvenih enačb; - povečevalni kriteriji; - uporaba računalniških orodij (npr.: *Mathematica, Comsol, Matlab*).	Energy balances: reaction and separation processes, enthalpy changes. Numerical solutions of ordinary differential equations: analytical method, Euler method, trapezoid method, common 4th order Runge-Kutta method, system of ordinary differential equations. Numerical solutions of partial differential equations: explicit and implicit finite difference methods, analytical and numerical solution of Laplace equation; writing down and solving conservation equations; Scale-up criteria; Software use (*Mathematica, Comsol, Matlab*,...).

Temeljna literatura in viri / Readings:

- I. Plazl in M. Lakner, Uvod v modeliranje procesov, Založba FKKT, Univerza v Ljubljani, Ljubljana, 2004, 230 str., (90 %).
- R. M. Felder in R. W. Rousseau, Elementary principles of chemical processes, 3. Izdaja, John Wiley and Sons, Inc., New York, 2000, 675 str., (30 %).

Dopolnilna literatura:

- C. F. Gerald in P. O. Wheatley, Applied numerical analysis, 7. izdaja, Addison Wesley, New York, 2003, 624 str.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje osvojijo osnovna načela zapisa energijskih bilanc in matematična orodja za reševanje ohranitvenih enačb. Študentje pri predmetu pridobijo naslednje specifične kompetence: - poznavanje splošnih načel zakona o ohranitvi energije; - poznavanje konstitutivnih zvez in obratovalnih pogojev; - sposobnost zapisa ohranitvenih enačb z upoštevanjem robnih pogojev; - poznavanje osnovnih matematičnih orodij za reševanje navadnih in parcialnih diferencialnih enačb.	Acquisition of knowledge on general concepts of energy conservation. Acquisition of knowledge on constitutional equations and operational conditions; writing down conservation equations by taking into account of boundary conditions. Using basic mathematical tools for solving ordinary and partial differential equations.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študentje pridobijo temeljna znanja o matematičnem zapisu ohranitvenih enačb z vključitvijo konstitutivnih zvez in upoštevanjem procesnih pogojev. Pridobljena znanja numeričnih metod jim omogočajo kvantitativno obravnavo in analizo preprostejših kemijskih procesov.	<u>Knowledge and Comprehension</u> Understanding the basic principles of energy and mass balance equations. Capability of implementing conservation balance equations by the use of mathematical tools.
<u>Uporaba</u> Pridobljena znanja je sposoben uporabiti pri samostojnem razvojnem in raziskovalnem delu na področjih analize, načrtovanja in optimizacije procesov.	<u>Application</u> Student is able to apply the knowledge at independent research and development work in the field of process analysis, design and optimization.

Refleksija Študent je sposoben samostojno sklepati, definirati problem, postavljati zaključke in probleme reševati.	Analysis Development of abilities of autonomous deducting, problem defining, problem solving, and coming to conclusions.
Prenosljive spretnosti Zna identificirati in reševati probleme, sposoben je zbiranja in interpretacije podatkov, kritične analize in sinteze pridobljenih znanj.	Skill-transference Ability Ability to identify and solve problems, to collect and interpret data, to analyse results critically and to synthesize knowledge.

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:

- 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:	KEMIJSKO PRODUKTNO INŽENIRSTVO
Course Title:	CHEMICAL PRODUCT ENGINEERING

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

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	IN133

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. Urška Šebenik / Dr. Urška Šebenik, 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):
- Definicija načrtovanja kemijskih produktov; - Piramida kemijskega produkta: materiali in sestava, uporaba, proces izdelave, struktura in lastnosti produkta; - Osnovni koraki pri načrtovanju produktov in procesov, ki vključujejo definicijo problema in potencialne tehnične rešitve ob upoštevanju ekonomskih, varstvenih in okoljskih dejavnikov; - Opredelitev in interpretacija potreb uporabnika kemijskega produkta; - Pretvorba potreb v specifikacije produkta; - Razvoj idej za zadovoljitev potreb uporabnika (načini iskanja in tvorjenja idej, izvori za potencialne ideje, določitev pomembnih	- Definition of chemical product design; - The chemical product pyramid: materials and composition, use, process, structure and performance of a chemical product; - Basic steps in product and process design with problem definition and possible technical solutions; - Definition and interpretation of market needs; - Converting needs to specifications; - Generation, collection and development of ideas for products that will satisfy marked needs; - Idea selection: verification of ideas' feasibility on the basis of thermodynamic laws and

dejavnikov za oblikovanje idej); - Izbor idej: ocena izvedljivosti idej na osnovi termodinamskih zakonitosti in kriterijev, ki jih opredeljujejo transportni pojavi in kemijska kinetika ob upoštevanju okoljskih, ekonomskih in proizvodnih tveganj; - Razvoj procesa za izdelavo produkta, ki vključuje zbiranje in selekcijo podatkov, končno specifikacijo produkta, določitev procesnih naprav in procesno shemo; - Načrtovanje kemijskega produkta na osnovi kemijske strukture; - Načrtovanje formuliranega produkta na osnovi mikrostrukture; - Preliminarna sinteza procesa na osnovi fizikalnih in kemijskih parametrov, kemijskih reakcij, transporta snovi in reciklov, separacijskih procesov, faznih sprememb - združevanje posameznih operacij v osnovne procesne sheme; - Primeri načrtovanja kemijskih produktov.	criteria, which are defined by transport phenomena and chemical kinetics and by taking into account economic, safety and environmental issues; - Development of a process for a product production based on data acquisition and selection, product specification, process equipment selection and process scheme; - Product design based on its chemical structure; - Formulated product design based on its microstructure; - Preliminary synthesis of the process on the basis of chemical and physical parameters, chemical reactions, mass transport, recycles, separation processes, phase changes - integration of operational units into a process scheme; - Case studies of chemical product design.

Temeljna literatura in viri / Readings:

- E. L. Cussler in G. D. Moggridge, Chemical Product Design, Cambridge University Press, Cambridge, 2nd Ed., 2011, 432 str., (80 %).
- J. A. Wesselingh, S. Kiil, M. E. Vigild, Design and Development of Biological, Chemical, Food and Pharmaceutical Products, John Wiley and Sons Ltd, Chichester, 2007, 293 str., (20 %).

Dopolnilna literatura:

- L. T. Biegler, I. E. Grossmann, A. W. Westerberg, Isues and Trends in the Teaching of Process and Product Design, AIChE Journal, 2010, 56(5), 1120-1125.
- W. D. Seider, J. D. Seider, D. R. Lewin, Product and Proces Design Principles, 2nd Ed., John Wiley & Sons, New York, 2004, 800 str..
- U. Bröckel, W. Meier in G. Wagner, Product Desgn and Engineering, Volume 1: Basics and Technologies, Wiley-VCH Verlag GmbH and Co. KgaA, Weinheim, 2007, 308 str..
- U. Bröckel, W. Meier in G. Wagner, Product Desgn and Engineering, Volume 2: Rawmaterials, Additives and Applications, Wiley-VCH Verlag GmbH and Co. KgaA, Weinheim, 2007, 394 str..

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje osvojijo metodološki pristop k razvoju novih produktov, ki vključuje analizo potreb. Študent osvoji različne stopnje razvoja kemijskih produktov in splošni pristop k definiranju potencialnih tehničnih rešitev ob upoštevanju ekonomskih, varstvenih in okoljskih dejavnikov.	Acquisition of methodological approaches for developing new products, including a market needs analysis; Understanding different stages of development of new products; Understanding general approaches for defining possible technical solutions by taking into account economical, safety and environmental

Študentje pri predmetu pridobijo naslednje specifične kompetence: - poznavanje načinov opredelitve in interpretacije potreb trga; - sposobnost uporabe kemijsko inženirskih znanj za izbiro idej in določevanje potencialnih rešitev; - sposobnost analize in interpretacije relevantnih podatkov; - razumevanje povezave kemijsko inženirskih znanj in ekonomskih dejavnikov za načrtovanje okolju sprejemljivih procesov; - razvijanje sposobnosti tehniškega mišljenja v okviru okoljskih dejavnikov; - poznavanje izbora relevantnih kemijskih in fizikalnih lastnosti, potrebnih za načrtovanje produkta; - sposobnost izbora posameznih operacij; - sposobnost sinteze naprav v integralno procesno shemo; - razumevanje načinov optimizacije predlaganih procesnih shem.	issues. Ability to define and interpret market needs; Ability to use chemical engineering knowledge to create ideas and define potential solutions; Ability to analyze and interpret relevant data; Understanding the relationships between economic and ecological issues; Development of technical thinking within the sphere of environmental factors; Ability to choose appropriate key chemical and physical properties needed for product design; Ability to select required operations; Ability to integrate operational units (apparatus) into a process scheme; Understanding the process scheme optimization approach.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent zna identificirati ključne dejavnike pri razvoju kemijskih produktov. Razume zvezo med osnovnimi kemijsko inženirskimi znanji in specifičnimi lastnostmi kemijskega produkta. Pozna osnovno metodologijo razvoja produkta in procesa za zadovoljitev potreb trga. Zna upoštevati ekonomske in okoljske dejavnike pri načrtovanju procesa za kemijski produkt.	<u>Knowledge and Comprehension</u> Ability to identify key factors in chemical product development; Understanding the relationship between basic chemical engineering knowledge and specific chemical product properties; Knowledge of the basic methodology for product and process development; Ability of identifying and taking into account economical, safety and environmental issues.
<u>Uporaba</u> Študent je pridobljena znanja sposoben uporabiti pri razvojnem in raziskovalnem delu na področjih razvoja in optimizacije produktov.	<u>Application</u> Acquired knowledge is necessary for work, research and development in the field of product development and optimization.
<u>Refleksija</u> Študent je sposoben sintetizirati pridobljena kemijsko inženirska znanja in jih uporabiti pri reševanju kompleksnih specifičnih problemov. Pridobljeno znanje mu omogoča aktivno komuniciranje in sodelovanje na	<u>Analysis</u> Student is able to synthesize chemical engineering knowledge to solve specific complex problems; Student is able of communication and cooperation in

interdisciplinarnih področjih.	interdisciplinary fields of work.
Prenosljive spretnosti Razvita sposobnost kritičnega razmišljanja in logičnega sklepanja. Sposobnost zbiranja in interpretacije podatkov ter sposobnost predstavitve rezultatov razvojnega in raziskovalnega dela.	Skill-transference Ability Ability of critical thinking and deduction; Ability of gathering, selecting and interpreting data. Ability of comprehensive results presentation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, obvezni seminarji – projektno delo v manjših skupinah	Lectures and mandatory seminars - project work in small groups

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Seminarska naloga – izvedba, pisno poročilo in predstavitev Pisni in ustni izpit		Project work - attendance, written report and presentation Written and oral exam

Reference nosilca / Lecturer's references:

- ALIČ, Branko, **ŠEBENIK, Urška**, KRAJNC, Matjaž. Microencapsulation of butyl stearate with melamine-formaldehyde resin : effect of decreasing the pH value on the composition and thermal stability of microcapsules. *Express polymer letters*, ISSN 1788-618X, 2012, vol. 6, no. 10, str. 826-836. [COBISS.SI-ID 36126469].
- **ŠEBENIK, Urška**, KRAJNC, Matjaž. Properties of acrylic-polyurethane hybrid emulsions synthesized by the semibatch emulsion copolymerization of acrylates using different polyurethane particles. *Journal of polymer science. Part A, Polymer chemistry*, ISSN 0887-624X, 2005, vol. 43, no. 18, str. 4050-4069. [COBISS.SI-ID 26883589]
- **ŠEBENIK, Urška**, KARGER-KOCSIS, József, KRAJNC, Matjaž, THOMANN, Ralf. Dynamic mechanical properties and structure of in situ cured polyurethane/hydrogenated nitrile rubber compounds: effect of carbon black type. *Journal of applied polymer science*, ISSN 0021-8995, 2012, vol. 125, no. S1, str. E41-E48. [COBISS.SI-ID 35685381]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	KEMIJSKO REAKCIJSKO INŽENIRSTVO
Course Title:	CHEMICAL REACTION ENGINEERING

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN131

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

Nosilec predmeta / Lecturer: doc. dr. Aleš Ručigaj / Dr. Aleš Ručigaj, Assistant Professional

Jeziki / Languages:

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

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

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

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Kemijska reakcija in stehiometrija. Kinetični in termodinamski podatki. **Teoretična napoved hitrosti reakcije.** Teorija trkov in teorija prehodnega stanja. Kinetične enačbe enostavnih in sestavljenih homogenih reakcij. **Kemijski reaktor.** Osnove dimenzioniranja. Snovna in toplotna bilanca. Oblika toka v reaktorju. Idealni in realni reaktorji. **Reaktorji za enostavne homogene reakcije.** Izotermni in neizotermni pogoji. Šaržni reaktor. Mešalni reaktor. Cevni reaktor. Mešalni reaktorji v vrsti. Cevni reaktor z obtokom. Adiabatni mešalni reaktor in stabilno obratovanje. **Reaktorji za vzporedne in zaporedne homogene reakcije.** Homogene

Content (Syllabus outline):

Chemical reaction and stiochiometry. Kinetic and thermodynamic data. **Theoretical predictions of the rate of reaction.** Theory of transition state. Kinetic equations of simple and complex homogenous reactions. **Chemical reactor.** Fundamentals of dimensioning. Mass and heat balance. Form of flow in a reactor. Ideal and real reactors. **Reactors for simple homogenous reactions.** Isotermal and non-isothermal conditions. Batch reactor. Stirred tank reactor. Tubukar reactor. Mixed flow reactors in series. Tubular recycle reactor. Adiabatic stirred tank reactor and stable operation. **Reactors for simultaneous and multistep homogenous reactions**. Homogenous

katalitske reakcije. Selektivnost. **Porazdelitev zadrževalnih časov (RTD) fluida v reaktorju.** Mikro in makro fluid. Vzbujevalno-odzivna tehnika. Pulzna in stopničasta motnja. Neposredna uporaba RTD krivulj. Disperzno-čepasti model. Model mešalnih reaktorjev v vrsti. Dvo in več-parametrski modeli.	catalytic reactions. Selectivity. **Residence time distribution (RTD) of fluid in a reactor**. Micro and macro fluid. Stimulus-response technique. Pulse and step stimulus. Direct application of RTD curves. Dispersion model. Tank in series mode. Two and multi-parameter models.

Temeljna literatura in viri / Readings:

- O. Levenspiel, *Chemical Reaction Engineering*, 3. izdaja, Wiley, 1999, 668 strani (70%).
- G. W. Roberts, *Chemical Reactions and Chemical Reactors*, 1. izdaja, Wiley, 2008, 452 strani (70 %).

Cilji in kompetence:	**Objectives and Competences:**
Predmet študentu razvija sposobnost analize in sinteze kompleksnih procesov s snovno pretvorbo (reakcijo), saj opovezuje kemijsko kinetiko in kemijsko termodinamiko na eni strani, z inženirsko termodinamiko in transportnimi pojavi na drugi. Tako ponuja znanja, ki so potrebna za obravnavanje in načrtovanje procesov s kemijsko reakcijo oziroma naprav (reaktorjev), ko te potekajo v eni sami (homogeni) fazi. Specifične kompetence predmeta so: - poznavanje, razumevanje in uporaba zakonov o ohranitvi mase, energije in gibalne količine, ko se kemijske pretvorbe odvijajo v homogeni fazi, - poznavanje, razumevanje in uporaba matematičnih zapisov hitrosti kemijskih pretvorb (kinetičnih enačb) v homogenih sistemih, poznavanje in razumevanje razlogov za odmik od idealnega toka v reaktorjih in reševanje takih problemov.	This course develops student ability for analysis and synthesis of complex processes with chemical transformation (reaction) since it links chemical kinetics and thermodynamics together with engineering thermodynamics and transport phenomena. It offers knowledge necessary to treat and design single phase chemical reaction processes and equipment. Specific competences are: - Knowing, understanding and using the laws of mass, energy and momentum conservation, when chemical reaction takes place in a homogenous phase, - Knowing, understanding and using mathematical expressions for chemical reactions (kinetic equations) in homogenous systems, - Knowing and understanding reasons for deviations from an ideal flow in reactors and solving such problems.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent spozna osnovne zakonitosti v zapisovanju hitrosti kemijskih in fizikalnih sprememb na infinitizemalni ravni reaktorja, ki po integraciji po prostoru reaktorja daje zvezo med obratovalnimi pogoji in reaktorjevim dobitkom na makro skali.	<u>Knowledge and Comprehension</u> Student learns basic principles of writing down kinetic equations for a infnitesimal reactor volume, which after integration in a space gives a relation between operation conditions and reactor yield on a macro scale.

Uporaba Ta znanja mu omogočajo analizo obratovanja obstoječih in načrtovanje novih reaktorjev za vodenje reakcij v enostavnih homogenih sistemih.	Application Knowledge enables performance analysis of existing reactors as well as design of reactors in simple homogenous systems.
Refleksija Študent je sposoben uporabiti znanja iz matematike, fizike, kemije, transportnih pojavov in pridobiti poglobljeno sliko o dogajanju v reaktorju na mikro nivoju. Pri zahtevnem načrtovanju kemijskih reaktorjev in drugih procesnih naprav, mu ta sposobnost omogoča tudi komuniciranje/sodelovanje z drugimi inženirji.	Analysis Student is able to use mathematical, physical, chemical and transport phenomena knowledge to obtain the profound picture of the processes in a reactor on a micro level.
Prenosljive spretnosti Študent je usposobljen za eksperimentalno delo z enostavnimi reakcijskimi sistemi, pa tudi za delo pri prenašanju eksperimentalnih rezultatov in literaturnih podatkov v industrijsko prakso. Sposoben je analizirati obstoječe naprave, določiti optimalne pogoje obratovanja in načrtovati nove reaktorje za homogene reakcijske sisteme.	Skill-transference Ability Student is capable to perform experimental work in simple reaction systems as well as transfer of experiemental and literature data to industrial practice. He can analyze the performance of existing equipment, estimate optimal operating conditions and design new reactors for homogenous systems.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in seminarji. V sklopu Kemijskega inženirskega praktikuma v 6. semestru študent opravi tudi eksperimente na treh osnovnih tipih reaktorjev in tako utrdi pridobljeno znanje.	Lectures and seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ustni in pisni izpit.		Written and oral exam.

Reference nosilca / Lecturer's references:

RUČIGAJ, Aleš, KRAJNC, Matjaž. Kinetic modeling of a crude DERA lysate-catalyzed process in synthesis of statin intermediates. Chemical engineering journal, ISSN 1385-8947. [Print ed.], 2015, vol 259, no. 1, str. 11-24.

RUČIGAJ, Aleš, ALIČ, Branko, KRAJNC, Matjaž, ŠEBENIK, Urška. Investigation of cure kinetics in a system with reactant evaporation : epoxidized soybean oil and maleic anhydride case study. European Polymer Journal, ISSN 0014-3057. [Print ed.], 2014, vol. 52, no. 1, str. 105-116.

ŠTIRN, Žiga, RUČIGAJ, Aleš, KRAJNC, Matjaž. Characterization and kinetic study of Diels-Alder reaction : detailed study on N-phenylmaleimide and furan based benzoxazine with potential self-healing application. Express polymer letters, ISSN 1788-618X, 2016, vol. 10, no. 7, str. 537-547.

RUČIGAJ, Aleš, KOBAL, Tjaž, ŠEBENIK, Urška, KRAJNC, Matjaž. Kinetic model of a Diels-Alder

reaction in a molten state : thermal and viscoelastic behaviour. Polymer bulletin, ISSN 0170-0839, 2019, vol. , iss. , str. 1-21.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	KVANTNA MEHANIKA
Course Title:	QUANTUM MECHANICS

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN117

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. Barbara Hribar Lee/ dr. Barbara Hribar Lee, 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 kvantne mehanike: fotoni, valovanje, delci. Principi: operatorji, lastne funkcije in lastne vrednosti, pričakovane vrednosti, Heisenbergov in Paulijev princip. Prehodi med kvantnimi stanji. Opis in reševanje enostavnejših sistemov: delci ob pregradah in v potencialnih jamah, togi rotator, harmonski oscilator, vodikov atom (atomske orbitale). Metode za približno računanje: variacijska metoda in metoda motenj. Modeli za obravnavanje molekulskih sistemov: teorija valenčnih vezi in teorija molekulskih orbital. Kemijska vez. Dvoatomne molekule, večatomne molekule in trdnine z molekularno orbitalno teorijo, gostotni funkcionali.	Introduction to quantum mechanics (quantum phenomena, photons, particles, waves); Principles (quantum operators, commutation, expectation values, Schrödinger equation); Heisenberg principle, wave – particle duality, Pauli principle. Transitions between quantum states, transition moments; Model systems (free particle, particle in a box, tunnelling effect, rotators, oscillators, hydrogen atom); Approximate calculations (variation methods, perturbation theory); Models for calculating molecular properties (molecular orbital method, valence bond theory); Chemical bond; Diatomic, polyatomic molecules and solid state systems with molecular orbital method, density

Računalniška kvantna kemija, glavne metode in računski modeli, pregled pomembnih računalniških sistemov na tem področju (Gaussian, Spartan, HyperChem ...), prikaz praktičnega dela z računalnikom na konkretnem problemu, individualno obravnavanje enostavnejših primerov s pomočjo metod računalniške kvantne kemije. Računalniška grafika.	functionals; Computational chemistry, important methods and computational models, overview of some computer programs (Gaussian, Spartan, HyperChem); presentation of practical work on a concrete problem using computer; Computer graphics.

Temeljna literatura in viri / Readings:

- R.L.Sproull, W. A. Phillips, Modern Physics: The quantum physics of atoms, solids, and nuclei, Dover Publication, 2015 (50%).
- J. Koller, Struktura atomov in molekul (bolonjski program),UL FKKT, Ljubljana 2010 (90%).

Dopolnilna literatur/Additional Literaure:

- A.R. Leach, Molecular Modelling, Principles and Applications, Addison Wesley Longman, London, 1998.
- J. Koller, Struktura atomov in molekul –zbirka nalog z rešitvami, UL FKKT, Ljubljana, 2018.

Cilji in kompetence:	**Objectives and Competences:**
Cilji: poznavanje elektronske strukture in geometrije molekul (iz osnovnih podatkov), napoved lastnosti molekul in njihova povezava s strukturo, možnost načrtovanja molekul z vnaprej določenimi želenimi lastnostmi. Predmetno specifične kompetence. Študent se nauči uporabljati računalniško grafiko. Spozna pomembne računalniške programe, ki se uporabljajo pri molekulskem modeliranju, sposoben je praktičnega dela na osebnem računalniku, delovni postaji in velikem računalniku (preko računalniške mreže).	***Learning outcomes:*** Understanding the basic principles of quantum mechanics and applying these principles in learning new perspectives of looking at the micro cosmos; Deriving the electronic structure and molecular geometry from the basic data. Designing new materials with required properties. ***Competences:*** Ability to use computer graphics and relevant computer programs for molecular modelling. Independent practical work on a PC or workstation; Interpreting the atomic structure and the structure of simple molecules; abilities for independent theoretical research.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent se seznani z osnovami kvantne kemije in njeni praktični uporabi, na primer pri molekulskem modeliranju, ki omogoča vpogled na nekatera eksperimentom nedostopna področja kemijske kot tudi znanosti s področja materialov. Ob koncu so sposobni formulirati problem, izbrati primerno teoretično metodo in kritično ovrednotiti dobljene rezultate. Zna tudi poiskati povezavo	<u>Knowledge and Comprehension</u> Students obtain the basic knowledge of quantum chemistry and its practical application, like molecular modelling, which enables them to have an insight of the properties of the matter that cannot be directly measured. At the end of the course they are able to formulate the problem, pick an appropriate theoretical method, and critically assess the results. They can correlate the obtained theoretical results

med dobljenimi teoretičnimi in v literaturi najdenimi podatki.	with the literature data.
Uporaba Slušatelj je sposoben uporabiti znanje kvantne kemije za modeliranje danega znanstvenega problema, komercialne računalniške programske sisteme s tega področja mu ni več potrebno uporabljati kot "black box", zaradi česar lahko tudi mnogo bolj kompetentno razlaga dobljene rezultate.	Application The students are able to apply the knowledge of quantum chemistry to model a given scientific problem. The commercially available software for this kind of problems does not need to be considered as a black box, and as such a more competent interpretation of the results is possible.
Refleksija Študent si pridobi občutek, da se lahko v primeru nepremostljivih eksperimentalnih težav še vedno zateče k računu, kjer so problemi drugačni in navadno drugje, kar pogosto privede do zadovoljive razjasnitve problema.	Analysis The students gain the knowledge that the experimental data can be interpreted through the theoretical methods, where different kinds of difficulties need to be overcome to obtain the meaningful results.
Prenosljive spretnosti Pri predmetu se študenti naučijo prepoznavati problem, ga prevesti v matematično obliko, rešiti 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 The students lear to recognize the problem, to formulate it in the mathematical language, and to interprete the results. Special attention is payed to critical assesment of the obtained results. They learn how to use the literature and to present a written report.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- Predavanja - Seminar (računske naloge iz predelane snovi) - Praktične vaje na računalniku	- Lectures - Seminars (Problem solving) - Practical work with the computer

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni (nadomestita ga lahko dva pozitivno ocenjena kolokvija) in ustni izpit.	**100 %**	Written and oral exam.

Reference nosilca / Lecturer's references:

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

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: IN101S

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:	MATEMATIKA II
Course Title:	MATHEMATICS II

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

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	IN112

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

Nosilec predmeta / Lecturer:	izr. prof. dr. Pavle Saksida / dr. Pavle Saksida, 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:

Funkcije več spremenljivk. Definicija funkcije dveh spremenljivk in njen graf. Limita in zveznost. Funkcija treh in več spremenljivk. Parcialni odvodi. Parcialni odvodi posrednih funkcij. Implicitne funkcije. Totalni diferencial in uporaba. Taylorjeva formula za funkcije dveh spremenljivk.

Ekstremi funkcij dveh spremenljivk. Definicija in pogoji za ekstrem. Uporaba ekstremov.

Dvojni in trojni integral. Definicija in lastnosti. Prevedba na večkratni integral. Uvedba novih spremenljivk. Primeri uporabe.

Osnovni pojmi diferencialne geometrije. Skalarna in vektorska polja. Odvod skalarnega polja v dani smeri, gradient skalarnega polja,

Content (Syllabus outline):

Functions of several variables. The definition of a function of two variables and its graph; The limit and continuity; Functions of three and more variables; Partial derivatives; The chain rule; Implicit functions; Total differential and applications; Taylor's formula for the function of two variables.

Extrema of functions of two variables. The definition and conditions for the extremum and applications.

Double and triple integrals. The definition, the properties; Evaluation with iterated integrals; Change of variables in a multiple integral; Examples of applications.

Concepts of differential geometry. Scalar and

divergenca in rotor vektorskega polja.
Krivulje in ploskve v prostoru. Vektor tangente na krivuljo in vektor normale na ploskev.
Krivuljni in ploskovni integrali. Definicije in računanje. Greenova formula, Gaussov in Stokesov izrek. Primeri in uporabe.
Fourierove vrste. Osnovni pojmi in primeri.
Parcialne diferencialne enačbe. Osnovni pojmi. Enačba za prevajanje toplote, Laplaceova enačba. Reševanje s Fourierovo vrsto.
Osnovni pojmi verjetnostnega računa. Definicija verjetnosti. Verjetnost vsote in produkta dogodkov. Slučajne spremenljivke, porazdelitvena funkcija. Matematično upanje in disperzija. Normalna porazdelitev.

vector fields; Directional derivative, gradient of a scalar field, the divergence and the curl of a vector field.
Curves and surfaces in the space. Tangent vector to a curve, normal vector to a surface.
Line and surface integrals. Definitions and evaluation; Theorems of Gauss, Stokes and Green; Examples and applications.
Fourier series. Basic concepts and examples.
Partial differential equations. Basic concepts; Heat equation; Laplace equation; Solving with the Fourier series.
Foundation of probability theory. The definition of the probability. Probability of the sum and of the product of events; Random variables; Probability distributions; Mean and variance; Normal distribution.

Temeljna literatura in viri / Readings:

- I. Vidav, Matematika II, DZS, Ljubljana, 1975, 576 str. (20%)
- M. H. Protter, C. B. Morrey, Intermediate calculus, New York, Springer, 1995, 555 str. (30%)

Dopolnilna literatura:

- I. Vidav, Matematika I, DZS, Ljubljana, 1973, 479 str.
- R. Jamnik, Matematika, DMFA Slovenije, Ljubljana, 1994, 568 str.
- P. Mizori-Oblak, Matematika za študente tehnike in naravoslovja II, FS, Ljubljana, 2003, 398 str.
- E. Kreyszig, Advanced engineering mathematics, New York-London-Sydney, J. Wiley, 1993, 898 str.

Opomba: v poštev pridejo le posamezni deli dopolnilnih učbenikov.

Cilji in kompetence:

Cilj predmeta: Študent naj bi v okviru tega predmeta spoznal nekaj novih pojmov in tehnik matematične analize, kot so funkcije več spremenljivk, dvojni, trojni, krivuljni in ploskovni integrali, osnove diferencialne geometrije, parcialnih diferencialnih enačb in verjetnosti. Ta znanja se uporabljajo pri mnogih področjih visokošolskega izobraževanja v naravoslovju, tehniki in nekaterih drugih strokah. Na predavanjih in vajah se študent uči matematičnega razmišljanja in strogosti, ter pridobiva praktično, delovno znanje obravnavanega

Objectives and Competences:

Objectives of the course: The student should in the context of this course meet a few new concepts and techniques of mathematical analysis such as functions of several variables, double and triple integrals, line and surface integrals, the foundation of differential geometry, basic concepts of the partial differential equations and of the probability theory. This knowledge is used in many areas of higher education in science, technology and in some other disciplines. At the lectures and exercises students learn the mathematical thinking and accuracy and acquire working

področja.	knowledge of the subject under consideration.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Poznavanje in razumevanje nadaljnjih pojmov diferencialnega, integralnega računa, funkcij več spremenljivk, diferencialne geometrije in osnov verjetnostnega računa.	Knowledge and Comprehension Knowledge and understanding of further concepts of differential and integral calculus, concepts of functions of several variables, concepts of differential geometry and foundation of the probability theory.
Uporaba Predmet Matematika III je nadaljevanje predmeta Matematika II. Namen teh osnovnih matematičnih predmetov je seznaniti študente z osnovnimi matematičnimi pojmi, ki se kasneje uporabljajo pri drugih inženirskih predmetih.	Application The course Mathematics III is a continuation of the course Mathematics II. The goal of these basic mathematical courses is to provide students with the fundamental mathematical notions needed later in other engineering courses.
Refleksija Povezovanje osvojenega znanja v okviru predmeta in njihova uporaba na drugih področjih.	Analysis Integration of acquired knowledge within the course and its application in many other areas.
Prenosljive spretnosti Sposobnost jasne formulacije določene vrste problemov v matematičnem jeziku in izbira primernih matematičnih metod. Zmožnost natančnega in samostojnega reševanja problemov ter spremljanje literature.	Skill-transference Ability The ability to clearly formulate certain types of problems into mathematical language and to choose the appropriate mathematical methods. The ability to accurately and independently solve problems and to follow the scientific literature.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, vaje, domače naloge, konzultacije.	Lectures, exercises, home works and the consultations.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Kolokviji, pisni izpiti, ustni izpiti. Ocene : 1-5 (negativno), 6-10 (pozitivno) (po statutu UL)		

Reference nosilca / Lecturer's references:

- Pavle Saksida: *On zero-curvature condition and Fourier analysis.* Phys. A: Math. Gen. **44** (2011), pp. 85203-85222
- Pavle Saksida: *Integrable anharmonic oscillators on spheres and hyperbolic spaces* , Nonlinearity **14** (2001), pp. 977-994
- Pavle Saksida: *Nahm's equations and generalizations of the Neumann system*, Proc. London Math. Soc. **78** (1999), pp. 701-720

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MATERIALI ZA INŽENIRJE
Course Title:	MATERIALS FOR ENGINEERS

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN121

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. Marjan Marinšek / Dr. Marjan Marinšek, 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:

- Uvod: Razdelitev in pregled osnovnih skupin materialov: kovine, polimeri, keramika, kompoziti, polprevodniški materiali, biomateriali. Opis vede o materialih in inženirstva materialov.
- Struktura atomov in kemijske vezi: Bohrov model atoma, Kvantno-mehanski model atoma, Nastanek kemijske vezi med elementi, Primerne vezi, Sekundarne vezi, Vpliv kemijskih vezi med gradniki na lastnosti materialov.
- Kristalna zgradba trdnin: Amorfnost in kristaliničnost, Kristalne strukture, Kristalografske smeri, Kristalografske

Content (Syllabus outline):

- Introduction: Classification of materials, Metals, Ceramics, Polymers, Composite, Semiconductors, Biomaterials. What is Materials Science and Engineering?
- Atomic Structure and Interatomic Bonding: Bohr model, Quantum-mechanic model, Atomic bonding, Primary interatomic bonds, Secondary bonding, Interatomic bonding and properties of materials
- The structure of crystalline solids: Amorphous and crystalline materials, Crystal structure, Points, directions and planes in the unit cell, Linear, planar and volume atomic density, Metalic crystal structures, Crystal structures of ionic materials, Density computations, Structure

ravnine, linearna, ploskovna in volumenska atomska gostota materiala, Struktura kovin, Struktura keramičnih materialov, Teoretična gostota materialov, Struktura polimerov, Polimorfizem in alotropija, Vpliv strukture materialov na njihove lastnosti.

- Napake v strukturi trdnin: Opis in pomen točkastih napak v materialih, Stehiometrija in podtehiometrija keramičnih materialov, Trdne raztopine, Nastanek in pomen dislokacij, Dvodimenzijske napake v kristalih, Volumenske napake v kristalih

- Difuzija v trdnem: Mehanizem difuzije v trdnem, Stacionarna difuzija, Določitev aktivacijske energije difuzije v trdnem, Nestacionarna difuzija in praktične rešitve 2. Fickovega zakona, Permeabilnost polimerov.

- Mehanske lastnosti snovi: Nateznostni preiskus, Opis osnovnih mehanskih lastnosti različnih skupin materialov, Elastična deformacija, Upogibni testi, Plastična deformacija materialov, Drsni sistemi, Zdrs v monokristalu, Plastična deformacija polikristaliničnega materiala, Utrjevanje materialov, Toplotna obdelava utrjenih materialov, Trdota

- Zlom materialov: Duktilen in krhek lom materialov, Udarni testi, Teoretična zlomna trdnost, Griffithova teorija, Zlomna žilavost, Utrujanje materialov, Lezenje.

- Fazni diagrami: Enokomponentni fazni diagrami, Gibbsovo fazno pravilo, Večkomponentni sistemi, Meja topnosti v trdnem, Tipični primeri dvokomponentnih faznih diagramov, Fazno pravilo vzvoda, Ravnotežni in neravnotežni fazni prehodi, Trikomponentni fazni diagrami, Jekla

- Fazne spremembe v materialih: Termodinamska gonilna sila fazne spremembe, Homogena in heterogena nukleacija, Hitrost fazne spremembe, TTT diagrami (time-temperature-transition), Difuzijske in brezdifuzijske fazne

of polymers, Crystalline structure and properties of materials

- Imperfections in solids: Point defects, Stoichiometric and non-stoichiometric materials, Solid solutions, Dislocations, Surface defects, Volume defects.
- Diffusion in solids: Diffusion mechanisms, Steady-state diffusion, Activation energy for diffusion, Nonsteady-state diffusion, Practical solutions of Fick's 2nd law, Permeability of polymers.
- Mechanical properties of materials: The tensile test, Stress-strain behaviour of various materials, Elastic deformation, Bend tests, Plastic deformation, Slip systems, Slip in single crystals, Plastic deformation of polycrystalline materials, Strengthening of materials, Recovery of mechanical properties, Hardness of materials.
- Mechanical failure of materials: Ductile and brittle fracture, Impact fracture testing, Principles of fracture mechanics, Griffith theory, Fracture toughness, Fatigue, Creep.
- Phase diagrams: Thermodynamic introduction, The Gibbs phase rule, Binary and ternary phase diagrams, Solubility limit, Examples of typical binary phase diagrams, Interpretation of phase diagrams, Equilibrium and nonequilibrium phase transitions, The Fe-Fe3C phase diagram, Steel.
- Phase transformations in materials: Thermodynamic introduction, Homogeneous and heterogeneous nucleation, Kinetics of phase transformation, Temperature-time-transition diagrams, Diffusion and nondiffusion phase transitions in steels, Precipitation strengthening, Shape memory mateials, Phase transformations in non-metallic systems.
- Electrical properties of materials: Band theory, Conductivity in metals and alloys, p and n semiconductors, Application of semiconductors, Insulators.
- Thermal properties of materials: Heat capacity and specific heat of mateials, Thermal expansion, thermal conductivity, Thermal shock.
- Magnetic properties of materials: Clasificatin

transformacije, Difuzijske in brezdifuzijske fazne transformacije v jeklih, Precipitacijsko utrjevanje, Materiali s spominom oblike, Nekatere fazne transformacije v nekovinskih sistemih • Električne lastnosti materialov: Teorija pasov, Principi električne prevodnosti v kovinah, Polprevodniki p in n tipa, Nekatere aplikacije polprevodniških materialov, Izolatorji • Termične lastnosti materialov: Toplotna kapaciteta materialov, Specifična toplota, Termična ekspanzija materialov, Toplotna prevodnost materialov, Toplotni šok • Magnetne lastnosti materialov: Klasifikacija magnetnih materialov, Osnove magnetizma, Feromagnetni-, ferimagnetni-, paramagnetni- in diamagnetni-materiali, Trdo- in mehko-magnetni materiali, Aplikacije magnetnih materialov Optične lastnosti materialov: Odboj, absorpcija in prepustnost materialov za svetlobo, Optična vlakna, Luminiscenca.	of magnetic materials, Basic concepts of magnetism, Ferromagnetic, ferrimagnetic, paramagnetic and diamagnetic materials, Soft and hard magnetic materials, Application of magnetic materials. Optical properties of materials: Reflection, absorption and transmission of light in materials, Optical fibers, Luminescence.

Temeljna literatura in viri / Readings:

1. Shackelford J.F., Introduction to Materials Science for Engineers, 7.th.ed.Prentice Hall PTR, New Jersey, 2008, 605 strani (60 %)
2. Callister W.D. Jr, Rethwisch, D. G., Materials science and Engineering- An Introduction, 9.th.ed. John Wiley& Sons, New York, 2013, 960 strani (20%)
3. Askeland D. R., Pradeep P. Fulay P.P., and Wright W. J., The Scinece and Engineering of Materials, 6.th.ed. Cengage Learning, Australia, 2010, 921 strani (20%)

Cilji in kompetence:	**Objectives and Competences:**
Študent bo pridobil znanja potrebna za osnovno oceno uporabnosti in primernosti določenih materialov za posamezne funkcije ali za kvalitetno napoved možnosti odpovedi gradiv, ki se uporabljajo bodisi kot komponente ali sestavni deli različnih struktur (gradbeni elementi ali strukture, reaktorske posode, stroji, naprave, sistemi in podobno). Pridobil bo celovita znanja o lastnostih materialov s poudarkom na kemijskih, fizikalnih in mehanskih lastnostih. Razumel bo zakaj in katere lastnosti so neodvisne od	The student acquires knowledge necessary for basic evaluation of usefulness and suitability of particular materials for individual functions or for predicting failure risk of materials used as components in various structures (construction elements or structures, reactor vessels, machines, devices, systems, ect.) The student acquires comprehensive knowledge of material properties especially chemical, physical and mechanical. Understanding why and which properties are preparation process independent and which are preparation and preparation

priprave, katere lastnosti pa so v bistvu odvisne od izbire procesa priprave in z njim določene mikrostrukture. Ob tem bo spoznal konkretne materiale (kovine, polimerne snovi, keramiko, kompozite idr.), ki se uporabljajo v industrijskih in drugih aplikacijah ter pridobil znanja potrebna za pravilno tolmačenje podatkov v priročnikih in bazah podatkov. To je še posebej pomembno kadar je gradivo izpostavljeno korozivni sredini ali drugim pogojem in obremenitvam, kjer prihaja do interakcije kemijskih, fizikalnih in mehanskih vplivov.	determined microstructure dependent. Acquaintance with specific materials (metals, polymers, ceramics, composites…) which are used in industrial and other applications. Acquisition of knowledge necessary for proper interpretation of manual and database data which is of special importance when materials are exposed to corrosive milieu or other conditions, where there is interaction between chemical, physical and mechanical influences.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študente bomo uvajali k samostojnemu, logičnemu in kritičnemu razmišljanju o lastnostih in uporabi različnih materialov.	Knowledge and Comprehension The student is encouraged to independent logical and critical thinking about properties and use of different materials.
Uporaba V okviru predmeta bo študent spoznal soodvisnost med sestavo, strukturo in mikrostrukturo materialov in njihovo uporabnostjo za različne namene ter pridobil znanja potrebna za sodelovanje z drugimi strokovnjaki pri izboru primernega materiala za določeno aplikacijo. Seznanjen bo z osnovnimi podatki potrebnimi za analizo tveganja in nevarnosti odpovedi pod normalnimi pogoji obratovanja in možnosti, da bo pri dodatnih obremenitvah materialov, zaostrenih ali izrednih razmerah prišlo do sprememb, ki povečajo tveganja do mere, nesprejemljive za varno obratovanje.	Application The course covers codependence between composition, structure microstructure and application for different uses. The student acquires knowledge of cooperation with experts from other fields when choosing adequate material for a certain application. The student is introduced to basic data necessary for risk assessment and failure risk under normal conditions of operation, under extreme conditions which cause changes increasing the risk until safe operation is impossible.
Refleksija Študent pridobi znanje za smoterno analizo uporabe izbranega materiala ter možnosti, da pri njegovi uporabi zaradi izrednih pogojev pride do neželenih sprememb.	Analysis The student acquires knowledge for rational analysis of use of a chosen material and risk of unwanted changes due to extreme conditions.
Prenosljive spretnosti Razvita sposobnost kritičnega razmišljanja in logičnega sklepanja. Sposobnost študija domače in tuje literature ter predstavitve rezultatov.	Skill-transference Ability Ability of critical thinking and deduction; Ability of studying relevant literature from the field of polymer materials and results presentation.

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

Predavanja, seminarji, laboratorijske vaje.	Lectures, computational seminars, practical course.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene laboratorijske vaje so pogoj za pristop k izpitu. Pisni izpit 50% Ustni izpit 50%		Accomplished laboratory practice are prerequisites to exam attendance. Written exam 50% Oral exam 50%.

Reference nosilca / Lecturer's references:

1. ŠTUKOVNIK, Petra, **MARINŠEK, Marjan**, MIRTIČ, Breda, BOKAN-BOSILJKOV, Violeta. Influence of alkali carbonate reaction on compressive strength of mortars with air lime binder. Construction & building materials, 2015, vol. 75, str. 247-254
2. JAPIĆ, Dajana, BITENC, Marko, **MARINŠEK, Marjan**, CRNJAK OREL, Zorica. The impact of nano-milling on porous ZnO prepared from layered zinc hydroxide nitrate and zinc hydroxide carbonate. Materials research bulletin, 2014, vol. 60, str. 738-745
3. **MARINŠEK, Marjan**, ŠALA, Martin, JANČAR, Boštjan. A study towards superior carbon nanotubes-supported Pd-based catalysts for formic acid electro-oxidation : preparation, properties and characterisation. Journal of power sources, 2013, vol. 235, no. 1, str. 111-116

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MEHANIKA FLUIDOV
Course Title:	FLUID MECHANICS

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN120S

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. Igor Plazl / Dr. Igor Plazl, 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):**
Temeljna vsebinska področja predmeta so: - splošni pojmi in definicije fluidne mehanike; - lastnosti kapljevin in plinov; - fluidna statika (masne, prostorninske in površinske sile, ravnotežje v tekočinah, hidrostatski pritisk, stisljivost tekočin); - fluidna dinamika; - opis toka tekočin, sile – gibanje in ravnotežje, fizikalne dimenzije, Newtonovi zakoni gibanja, snovne lastnosti, spremenljivke toka tekočin; - opis toka tekočin - statičen/dinamičen, stacionaren/nestacionaren; - enačba gibanja za viskozne tekočine - napetost, tenzor napetosti, simetrija tenzorja napetosti, tenzor napetosti za Newtonijske tekočine, Navier-Stokesova	- General concepts and definitions of fluid mechanics; - properties of liquids and gases; - fluid statics (mass, volumetric and surface force, equilibrium in liquids, hydrostatic pressure, compressibility of liquids); - fluid dynamics; - fluid flow, forces – motion and equilibrium, physical dimensions, Newton's laws of motion, matter properties, variables of fluid flow; - types of liquid flow - static/dynamic, stationary/nonstationary; - equation for motion in viscous fluids - stress, stress tensor, symmetry of stress tensor, stress tensor in Newtonian liquids, Navier-Stokes equation, boundary conditions; - continuity equation;

enačba, robni pogoji; - kontinuitetna enačba; - viskoznost - mikroskopska slika viskoznosti plinov in kapljevin; - analitične rešitve Navier-Stokesovih enačb; - laminarno in turbulentno strujanje tekočin; - mehanska energijska bilanca in Bernoullijeva enačba, torni koeficient in izračun linijskih izgub; - dimenzijska analiza in kriterij dinamične podobnosti; - uvod v teorijo mejnih plasti in turbulence; - mešanje; - strujanje tekočin skozi porozne medije.	- viscosity - microscopic picture of the viscosity of gases and liquids; - analytical solutions of Navier-Stokes equations; - laminar vs turbulent flow of liquids; - mechanical energy balance and Bernoulli's equation, coefficient of friction and calculation of linear loss; - dimensional analysis and criterion of dynamic similarity; - introduction to the theory of boundary layers and turbulence; - mixing; - movement of liquids through porous media.

Temeljna literatura in viri / Readings:

R.W. Fox, A.T. Mc Donald, R.J. Pritchard, Introduction to Fluid Mechanics, 6. edition, Wiley & Sons Inc, New York, 2006, 779 pp., (30%).

Dodatna literature/Additional reading:

R.B. Bird, W.E. Stewart, E.N. Lightfood, Transport Phenomena, 2. edition, Wiley VCH, New York, 2001, 895 pp.

W.B. Krantz, Scaling Analysis in Modeling Transport and Reaction Processes, Wiley VCH, New York, 2007, 530 pp.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje osvojijo načela fluidne mehanike, ki predstavljajo osnovo za razumevanje in kvantitativno obravnavanje konvektivnega prenosa toplote in snovi. Študentje si pri predmetu pridobijo naslednje specifične kompetence: - poznavanje mehanskih načel toka tekočine; - poznavanje hidrostatike; - poznavanje napetosti v tekočinah; - sposobnost zapisa ohranitvenih enačb za maso in gibalno količino; - poznavanje elementarnih konstitutivnih zvez; - sposobnost eksaktnega reševanja Navier-Stokesovih enačb; - poznavanje mehanske energijske bilance in Bernoullijeve enačbe; - poznavanje metod za izračunavanje	Understanding mechanical principles of fluid flow; hydrostatics; pressure in liquids; writing down conservation equations for mass and momentum; understanding elementary constituent relationships; ability for exact solving of Navier-Stokes equations; mechanical energy balance and Bernoulli's equation; methods for calculating the fluid flow and mixing devices in a liquid medium; knowing the methods for calculating the pressure loss during a flow through porous media; ability for setting and solving problems in fluid mechanics.

naprav za pretok tekočin in naprav za mešanje v tekočem mediju; - poznavanje metod za izračunavanje padcev pritiska pri pretoku skozi porozne medije; - sposobnost nastavljanja in reševanja problemov fluidne mehanike.	

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študentje pridobijo temeljna znanja o statiki in dinamiki tekočin ter razumevanje načel fluidne mehanike, ki vključujejo ohranitvene enačbe za maso, energijo in gibalno količino.	Knowledge and Comprehension Students will acquire the principles of fluid mechanics which is fundamental for understanding and making quantitative analyses of convective transfer of heat and matter.
Uporaba Uporaba načel fluidne mehanike študentom omogoča analizo in nastavitev problemov, analitično reševanje preprostejših primerov in z uporabo matematično računalniških orodij tudi iskanje numeričnih rešitev zahtevnejših realnih problemov. Študentje tako pridobijo uporabna znanja za opis in načrtovanje (bio)kemijskih procesov in naprav, ki vključujejo tok tekočin.	Application Student can theoretically describe the fluid flow and predict velocity profiles for some simple flows.
Refleksija Na osnovi pridobljenih teoretičnih znanj in praktičnih vaj, študentje pridobijo veščine za analizo procesov, ovrednotenje podatkov in prenos znanja v raziskovalni in/ali tehnološki proces.	Analysis Theoretical knowledge gained during the course can be efficiently transferred into descriptions of chemical and biochemical processes.
Prenosljive spretnosti Uporaba različnih literaturnih virov (knjige, članki, elektronsko gradivo) omogoča zbiranje podatkov oziroma vrednotenje lastnih rezultatov in njihovo interpretacijo ter preverjanje pravilnosti. Končni rezultat je boljše razumevanje proučevanega procesa. Hkrati se razvijajo sposobnosti za vključevanje v skupinsko delo, komunikacijo in pripravo pisnega materiala.	Skill-transference Ability Identification and solving of problems. Experimental data collection, analysis and critical evaluation of results. The use of scientific literature, writing and presentation of reports.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- predavanja, - seminarske naloge	Lectures, seminars.

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

Reference nosilca / Lecturer's references:

- POHAR, Andrej, LAKNER, Mitja, PLAZL, Igor. Parallel flow of immiscible liquids in a microreactor : modeling and experimental study. *Microfluid. nanofluid*. (Print), 2012, vol. 12, no. 1/4, str. 307-316.
- POHAR, Andrej, PLAZL, Igor. Laminar to turbulent transition and heat transfer in a microreactor : mathematical modeling and experiments. *Ind. eng. chem. res*.. [Print ed.], 2008**,** vol. 47, no. 19, str. 7447-7455.
- NOVAK, Uroš, POHAR, Andrej, PLAZL, Igor, ŽNIDARŠIČ PLAZL, Polona. Ionic liquid-based aqueous two-phase extraction within a microchannel system. Separation and purification technology, ISSN 1383-5866, 2012, vol. 97, no. 1, str. 172-178.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MEHANSKE IN HIDRODINAMSKE OPERACIJE
Course Title:	MECHANICAL AND HYDRODINAMIC OPERATIONS

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

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: INSI34

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

Nosilec predmeta / Lecturer: prof. dr. Igor Plazl /
Dr. Igor Plazl, 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: Osnovne faze kemijskega procesa: priprava, kemijska pretvorba, izolacija in čiščenje produkta in osnovne operacije. Mehanske operacije: Karakteriziranje grobo disperznih sistemov, velikost delcev. Procesi večanja površin, mletje, drobljenje. Procesi manjšanja površin, aglomeriranje. Procesi razvrščanja po velikosti, sejanje. Primeri izbire in dimenzioniranja naprav. Hidrodinamske operacije: Posedanje v gravitacijskem polju. Stokesov zakon. Posedalne naprave. Fluidizacija. Posedanje v centrifugalnem polju. Naprave: centrifuga, ciklon. Ločevanje trdno tekoče-filtracija.	Introduction: Basic steps of chemical process: Preparation, chemical conversion, isolation and cleaning of the product - basic operations. Mechanical operations: Characterization of coarse-grained disperse systems, particle size. Processes for increasing particle surface: crushing and milling. Processes for decreasing particle surface, agglomeration. Process of particle size classification, sieving. Equipment for crushing and grinding. Examples of apparatus dimensioning and its selection. Examples of selection and dimensioning of devices for crushing and grinding. Hydrodynamic operations: Settling under

Klasična filtracija, načini obratovanja in naprave. Obtočna filtracija: mikrofiltracija, ultrafiltracija, reverzna osmoza. Osnovni principi, vrste membran in membranskih modulov. Mešanje. Osnovni principi in naprave. Mešanje v sistemih tekoče, tekoče-plin in tekoče-trdno. Primeri izbire in dimenzioniranja posameznih naprav. Primeri sinteze posameznih mehanskih in hidrodinamskih operacij v tehnološki proces.	gravity. Stoke's law. Liquid-solid separation methods. Sedimentation, industrial thickeners and clarifiers. Fluidization. Settling in centrifugal field. Equipment: centrifuge and cyclone separators. Filtrations: classical filtration – operation mode and devices, reflux filtration methods: microfiltration, ultrafiltration and reverse osmosis; basic principles, types of membranes and membrane modules. Mixing. Basic principles and mixing devices mixing in systems: liquid-liquid, liquid – gas and liquid solid. Examples of selection and dimensioning of devices for mixing. Examples of synthesis of individual mechanical and hydrodynamic operations in technological processes.

Temeljna literatura in viri / Readings:

- J.H.Harker, J.R.Backhurst, J.F.Richardson, Chemical Engineering, Volume 2, Elsevier, 2002. 1232 str (20%)

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je študente seznaniti pomenom mehanskih in hidrodinamskih operacij v kemijskem inženirstvu. Predmetno specifične kompetence: - študent spozna posamezne operacije kot sestavni del kemijsko tehnološkega procesa, - razume posamezne operacije in delovanje aparatov in zna napravo za določen tehnološki proces.	Objective of the course is to acquaint students with the meaning of mechanical and hydrodynamic operations in chemical engineering. Subject specific competences: - Student learns individual operations as an integral part of the chemical technological process - Student understands particular operations and device operation for a certain technological process.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent je po osvojitvi pojmov, zakonitosti, teorij in pojavov, ki jih podaja ta predmet, sposoben razumeti specifičnosti posamezne operacije in vloge v tehnološkem procesu.	<u>Knowledge and Comprehension</u> When student understands concepts, laws, theories and phenomena, which are subjects of presented course, he/her is capable to recognize the specifics of individual operations and the role in the technological process.
<u>Uporaba</u> Pridobljena znanja je sposoben uporabiti pri izbiri in dimenzioniranju posameznega aparata oziroma načrtovanju in vodenju posameznega tehnološkega procesa.	<u>Application</u> By acquired knowledge student gains skill for selecting and dimensioning devices, and competences for planning and conduct of an individual technological process.

Refleksija Uporaba splošnih znanj in osnovnih principov kemijskega inženirstva, analiza in kritično ovrednotenje tehnološkega procesa oziroma posameznega postopka in naprave.	Analysis The use of general knowledge and basic principles of chemical engineering; analysis and critical evaluation of technological process and/or specific procedure and device.
Prenosljive spretnosti Razvita sposobnost identifikacije in reševanja problemov, kritičnega razmišljanja in logičnega sklepanja. Sposobnost uporabe literature, zbiranja in interpretacije podatkov in njihove kritične evalvacije.	Skill-transference Ability Evolved capability to identify and to solve problems, critical consideration and logical reasoning. The capability of collecting literature and data interpretation.

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- Pisni in ustni izpit - poročila iz laboratorijskih vaj - pisna seminarska naloga.	**60 %** **20 %** **20 %**	- Written and oral exam; - Laboratory work : written report, - Written seminar

Reference nosilca / Lecturer's references:

1. LUBEJ, Martin, PLAZL, Igor. Theoretical and experimental study of iron catalyst preparation by chemical vapor deposition of ferrocene in air. The chemical engineering journal, 2014, vol. 242, no. 1, pp. 306-312.
2. MILOŽIČ, Nataša, LUBEJ, Martin, NOVAK, Uroš, ŽNIDARŠIČ PLAZL, Polona, PLAZL, Igor. Evaluation of diffusion coefficient determination using a microfluidic device. Chemical and biochemical engineering quarterly, 2014, vol. 28, no. 2, pp. 215-223.
3. NOVAK, Uroš, LAKNER, Mitja, PLAZL, Igor, ŽNIDARŠIČ PLAZL, Polona. Experimental studies and modeling of [alpha]-amylase aqueous two-phase extraction within a microfluidic device. Microfluidics and nanofluidics, 2015, 19:75–83

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: KI104

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:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
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,	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.

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.

<u>Molecular basis of cellular processes</u>

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.

Biochemistry of sensory organs.

Temeljna literatura in viri / Readings:

- Boyer: Temelji biokemije (Študentska založba, 2005). 576 strani. (50%)

Cilji in kompetence:

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.
Predmet temelji na povezovanju teoretičnih osnov z laboratorijskim in seminarskim seznanjanjem predvsem z lastnostmi in primeri funkcije makromolekul. Študenti se bodo pri vajah urili v natančnosti

Objectives and Competences:

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 measurements will be trained and discussed. By

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.	writing a laboratory logbook, students will learn how to report experimental results and interpret them.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje 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.	Knowledge and Comprehension 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.
Uporaba 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.	Application 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.
Refleksija 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.	Analysis 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		

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 KEMIJA
Course Title:	ORGANIC CHEMISTRY

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

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	IN113

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

Nosilec predmeta / Lecturer:	izr. 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):**
a) Struktura in reaktivnost organskih spojin - Pregled, fizikalne lastnosti in nomenklatura organskih spojin - Kemijske vezi ter premiki elektronov - Konformacije in stereokemija - Tok elektronov, odcep protona, intermediati - Stereoelektronski vplivi substituent na pretvorbe organskih molekul - Pregled osnovnih tipov transformacij organskih spojin **b) Pretvorbe organskih spojin** - Kemija alkanov: nukleofilne, elektrofilne in radikalske substitucije; eliminacijske reakcije - Kemija alkenov: elektrofilne, nukleofilne in	Structure and reactivity of organic compounds – survey, physical properties, and nomenclature of organic compounds – Chemical bonds – Conformations and stereochemistry – Electron flow, deprotonation, intermediates – Stereoelectronic effects of substituents – Basic types of organic transformations. Transformations of organic compounds – Chemistry of alkanes: nucleophilic, electrophilic, and radical substitutions; elimination reactions – Chemistry of alkenes: electrophilic, nucleophilic, and radical substitutions

radikalske adicije - Kemija aromatov: elektrofilne, nukleofilne in radikalske substitucije - Kemija karbonilov: nukleofilne, elektrofilne in radikalske adicije, adicije-substitucije ter adicije-eliminacije - Oksidacije in redukcije	– Chemistry of aromatics: electrophilic, nucleophilic, and radical substitutions – Chemistry of carbonyls: nucleophilic, electrophilic, and radical additions, addition-substitution, addition-elimination – Oxidations and reductions.

Temeljna literatura in viri / Readings:

- J. McMurry: Fundamentals of Organic Chemistry, Brooks/Cole Cengage Learning, 7th Edition, Pacific Grove 2011, 598 pages (70%).
- J. McMurry: Organic Chemistry, Brooks/Cole Brooks/Cole Cengage Learning, 8th Edition, Pacific Grove 2012, 1262 pages (30%).

Cilji in kompetence:	**Objectives and Competences:**
Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc: -osnovno znanje organske kemije -poznavanje nomenklature organskih spojin -poznavanje strukturnih značilnostih organskih spojin, funkcionalnih skupin in njihovih pretvorb -poznavanje reaktivnosti organskih spojin in tipičnih organskih reakcij -poznavanje osnov organske stereokemije -poznavanje reakcijskih mehanizmov in intermediatov -poznavanje osnovnih principov organske sinteze -poznavanje dostopanja do literaturnih virov in njihove uporabe	Basic knowledge of organic chemistry: nomenclature, structural features, functional groups, reactivity, and typical transformations of organic compounds. Basic knowledge of organic stereochemistry, reaction mechanisms and intermediates. Knowledge of the basic principles of organic chemistry and accessing literature sources. Competences: Basic knowledge of organic chemistry: nomenclature, structure, reactivity and transformations of organic compounds. Ability to understand structure-reactivity relationship, i.e. to predict chemical properties of a given organic compound from its structure and vice versa.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje *Študent pozna in razume:* -organske spojine glede na strukturo osnovnega skeleta in tipične funkcionalne skupine -izomerijo in nomenklaturo organskih spojin -osnovne pretvorbe organskih spojin -značilne reagente, ki se uporabljajo pri osnovnih organskih reakcijah.	Knowledge and Comprehension Student understands and is familiar with: – Structure of organic compounds and functional groups – Isomerisation and nomenclature of organic compounds – Basic transformations of organic compounds Typical reagents used for performing basic organic reactions.

Uporaba Znanje organske kemije je temeljno znanje, ki je osnova za študij kemijskega inženirstva in se hkrati navezuje na veliko ostalih predmetov študija. Poleg tega je osnovno teoretično in praktično znanje organske kemije nujno potrebno vsakemu kemijskemu inženirju pri njegovem kasnejšem delu v praksi.	Application Mastered knowledge of organic chemistry is basic knowledge needed for studding chemical engineering. The knowledge is interconnected with majority of other subjects concerning the program. Course is also fundamental for understanding biochemistry subjects and curses concerning organic materials and ecology.
Refleksija Znanje organske kemije sodi med temeljna kemijska znanja in je pogoj za uspešno delo na vseh ostalih področjih kemijskega inženirstva. Predmet je tudi osnova za razumevanje biokemijskih predmetov ter predmetov povezanih z organskimi materiali in ekologijo.	Analysis The topics of other courses and laboratory trainings are connected to the topics of lectures. Therefore, the student learns critical assessment (evaluation) of practical results with respect to the theory.
Prenosljive spretnosti -Poznavanje organske kemije kot temeljnega znanja za specifična področja kemijskega inženirstva -Poznavanje strukture in reaktivnosti organskih spojin -Uporaba organskih sinteznih principov na ostalih področjih kemijskega inženirstva in materialov	Skill-transference Ability The student acquires skills that are required for a laboratory work and for handling with chemicals. The knowledge on organic chemistry enables better understanding of the basic principles of other subjects and courses within the study of Chemical engineering.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji.	Lectures, seminar work, theoretical training by analytical solving of strategic problems.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni (nadomestita ga lahko dva pozitivno ocenjena kolokvija) in ustni izpit.		Written and oral exam.

Reference nosilca / Lecturer's references:

- ŠTEFANE, Bogdan. Selective addition of organolithium reagents to BF[sub]2-chelates of [beta]-ketoesters. *Organic letters*, ISSN 1523-7060, 2010, vol. 12, no. 13, str. 2900-2903, doi: 10.1021/ol100620j. [COBISS.SI-ID 34162181]
- 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]
- 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 INŽENIRSTVA
Course Title:	ENGINEERING FUNDAMENTALS

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN105

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 Dular / Dr. Matevž Dular, 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: pomen tehnike v svetu in znanosti **Elektrotehnika:** lastnosti električnega toka, elektromagnetno polje in elektromotorji, uporaba elektromotorjev, različne vrste elektromotorjev, mehansko in elektronsko kmutirani elektromotorji, asinhroni in sinhroni elektromotorji, transformatorji, krmiljenje in regulacija, vodenje energetskih sistemov **Strojništvo**: materiali (preizkušanje, jekla in litine, aluminij, baker, keramika, kompozitni materiali, polimeri) hrup,prenos toplote (prevajanje, prestop, sevanje), prenosniki toplote, energetski stroji (volumenski in turbinski) **Gradbeništvo**: hidravlične meritve **Seminarji**: Proizvodnja steklene in kamene	**Introduction**: the importance of technology in the world and science **Electrotechnics**: electrical current properties, electromagnetic field and electric motors, use of electric motors, various types of electric motors, mechanically and electronically commutated electric motors, asynchronous and synchronous electric motors, transformers, control and regulation, regulation of power systems **Mechanical engineering**: materials (testing, steels and alloys, aluminum, copper, ceramics, composite materials, polymers) noise, heat transfer (concuction, convection, radiation), heat exchangers, energy machines (volumetric and turbine)

volne, komunalne čistilne naprave, delovanje gospodinjskega sušilnega stroja, merjenje sestave plinov in delcev v izpušnih plinih vozil, z notranjim zgorevanjem, sistemi za posnemanje podatkov	**Civil engineering**: hydraulic measurements **Seminars**: Production of glass and stone wool, municipal wastewater treatment plants, operation of a household tumble dryer, measurement of the composition of gases and particles in exhaust of internal combustion engines, data acquisition systems

Temeljna literatura in viri / Readings:

Marko Hočevar, Matevž Dular, Osnove inženirstva, študijsko gradivo, 233 strani, FKKT, 2017

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je študente seznaniti z značilnostmi in koncepti kemijsko inženirske stroke in njeno vlogo v svetu tehnike. Predmetno specifične kompetence: - študent spozna kemijsko proizvodno linijo in prepletanje posameznih tehniških strok na poti od surovine do produkta - študent spozna značilnosti kemijsko tehnološkega procesa ter koncept osnovnih operacij in reakcij v njem - razume procesno shemo in pomen posameznih naprav za določen kemijsko tehnološki proces.	The objective is to acquaint the student with characteristics and concepts of chemical engineering and its role in the technical world. Specific competences are: - student recognizes chemical production line and and interaction of particular technical disciplines on the way from raw materials to a product, - student recognizes characteristics of chemical process technology together with the concept of unit operations and chemical reaction, - understands the process scheme and the role of individual equipment for a particular chemical process technology.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent je po osvojitvi osnovnih pojmov in principov tehnike, ki jih podaja ta predmet, sposoben razumeti specifičnosti kemijsko inženirske stroke ter pomena osnovnih operacij v tehnološkem procesu v kemijski industriji.	<u>Knowledge and Comprehension</u> After mastering basic technical concepts and principles given by the present course, student is able to understand specifics of chemical engineering discipline and the role of unit operations in chemical process technology on industrial scale.
<u>Uporaba</u> Pridobljeno osnovno in splošno tehnično izobrazbo bo koristno uporabil v nadaljevanju študija za nadgradnjo s specifičnimi in poglobljenimi kemijsko inženirskimi znanji, kar bo omogočalo reševanje posameznih	<u>Application</u> Acquired basic and general technical knowledge will be usefully served during the future study for the upgrade with specific and profound chemical engineering knowledge. This will enable solving practical cases and problems in

praktičnih primerov in problemov v industrijskih kemijsko tehnoloških procesih.	chemical process technology on industrial scale.
Refleksija Uporaba splošnih tehničnih znanj in osnovnih principov kemijskega inženirstva, analiza in kritično ovrednotenje kemijsko tehnološkega procesa oziroma posameznega postopka in naprave.	Analysis Use of general technical knowledge and basic principles of chemical engineering, analysis and critical evaluation of chemical process technology as whole or only its particular operation or equipment.
Prenosljive spretnosti Razvita sposobnost identifikacije in reševanja tehničnih problemov, kritičnega razmišljanja in logičnega sklepanja. Sposobnost uporabe literature, zbiranja in interpretacije podatkov in njihove kritične evalvacije.	Skill-transference Ability Developed skill to identify and solve technical problem, critical thinking and making logical conclusions. Ability of literature data using, data collection and interpretation as well as their critical evaluation.

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	**100%**	

Reference nosilca / Lecturer's references:

STEPIŠNIK PERDIH, Tadej, ZUPANC, Mojca, DULAR, Matevž. Revision of the mechanisms behind oil-water (O/W) emulsion preparation by ultrasound and cavitation. Ultrasonics Sonochemistry, ISSN 1350-4177, Mar. 2019, vol. 51, str. 298-304

STEPIŠNIK PERDIH, Tadej, ŠIROK, Brane, DULAR, Matevž. On the bubble-surfactant interaction. Chemical engineering and processing, ISSN 0255-2701. [Print ed.], Nov. 2017, vol. 121, str. 198-204

ŽNIDARČIČ, Anton, METTIN, Robert, DULAR, Matevž. Modeling cavitation in a rapidly changing pressure field - application to a small ultrasonic horn. Ultrasonics Sonochemistry, ISSN 1350-4177, Jan. 2015, vol. 22, str. 482-492

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVE OKOLJSKEGA INŽENIRSTVA
Course Title:	INTRODUCTION TO ENVIRONMENTAL ENGINEERING

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

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: INSI2

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: doc. dr. Gabriela Kalčíková /
Dr. Gabriela Kalčíková / 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:

Osnove okoljske problematike: osnovni procesi v okolju, soodvisnost elementov okolja, orodja okoljskega inženirja, kvantifikacija okoljskih problemov, lokalni in globalni okoljski vplivi človeka, trajnostni razvoj, etična izbira, ekonomski principi.

Onesnaženje: viri, tipične vrste in vplivi, dinamika onesnaženja, mehanizmi transporta, elementi in principi ekologije, kinetika (bio)kemijskih reakcij, večfazni sistemi in interakcije, masne bilance ekosistemov, zakonodaja.

Vode: hidrološki cikel, kemija površinskih in odpadnih vod ter podtalnice, parametri za

Content (Syllabus outline):

Fundamentals: Basic environmental processes, fundamentals of ecosystems, relationship between environmental compartments, resources and society, quantification of regional, local and global impacts, engineering approaches, economics and the environment, sustainable development, ethics and engineering decisions.

Pollutants: types, origins, effects, fate in the environment, mass transport, transformation, kinetics of (bio)chemical reactions, multi-phase systems, environmental mass balances, legislation.

vrednotenje kvalitete vode, osnove izbire in dimenzioniranja naprav za pripravo pitnih in tehnoloških vod, zbiranje in transport odpadnih vod, načini čiščenja in osnove dimenzioniranja čistilnih naprav (konvencionalne in napredne tehnologije, kombinacije različnih tehnologij), postopki obdelave blata iz čistilnih naprav. Tla: transport polutantov, pregled remediacijskih tehnik (In situ in Ex situ biološke in fizikalno-kemijske metode) Zrak: primarni in sekundarni polutanti, kemija zračnih polutantov (regijski in globalni pojavi), mobilni in stacionarni viri polutantov, lokalni in globalni problemi, osnove modeliranja disperzij polutantov, tehnologije kontrole emisij, recikliranje, osnove načrtovanja in dimenzioniranja čistilnih naprav. Trdni odpadki: karakterizacija odpadkov, zbiranje in ravnanje z odpadki (nevarni in nenevarni), snovna in energetska izraba, deponije in termična obdelava.	Water: hydrological cycle, sources and effects of pollution, chemistry of surface, underground and wastewaters, water quality assessment parameters, systems used in water supply, systems for conditioning of drinking and industrial waters, wastewater collection systems, wastewaters and their treatment (conventional and advanced processes, combinations), sludge treatment and disposal. Soil: Transport and fate of pollutants, remediation and bioremediation techniques (In Situ and Ex Situ biological and physico-chemical methods). Air: Primary and secondary pollutants, fundamentals of air chemistry, regional and global pollution, stationary and mobile sources of pollutants and problems (consequences, possible solutions), fundamentals of modelling of pollutants dispersions, treatment and control technologies, fundamentals of treatment plant design, recycling of pollutants. Solid waste: solid waste collection and disposal, resource recovery, hazardous waste processing and handling, material and energy recovery, landfilling and thermal processing

Temeljna literatura in viri / Readings:

- P.A. Vesilind, S.M. Morgan: *Introduction to Environmental Engineering,* 2nd Ed., Thomson Brooks/Cole, London, 2004, 479 strani (30%)
- M.L. Davis, S.J. Masten: *Principles of Environmental Engineering and Science,* McGraw-Hill, 2004, 704 strani, (10%).

ŽGAJNAR GOTVAJN, Andreja, ZAGORC-KONČAN, Jana. *Osnove okoljskega inženirstva : praktikum*. 1. izd. Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo, 2015 (100%)

Dodatna literatura:

- G.M. Masters: *Introduction to Environmental Engineering and Science*. 2nd Ed., Prentice-Hall International, London, 1998, 651 strani (20%).
- J.Zagorc-Končan, A. Žgajnar Gotvajn: *Zbirka nalog iz ekološkega inženirstva*, UL, FKKT, 2008, 45 strani.

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Razvijati zavest in znanje za kritičen in kvantitativen sistematičen interdisciplinaren inženirski pristop k okoljskim problemom. Kompetence: Poznavanje osnovnih procesov v okolju, vplive polutantov na okolje, poznavanje metod preprečevanje onesnaženja in čiščenja obstoječega onesnaženja. Sposobnost prenosa teoretičnih znanj v prakso za reševanje konkretnih okoljskih problemov ob upoštevanju ekonomskih, etičnih in zakonskih omejitev.	Objectives: Development of knowledge and awareness for critical and quantitative interdisciplinary approach of an engineer to environmental problems. Specific competences: Knowledge on fundamental processes in the environment and the impact of different pollutants. Knowledge principles of pollution prevention, tretament and remediation. Development of ability to transfer theoretical knowledge into practice to solve actual environmental problems within economical, social and legislative limits.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Razumevanje kompleksnih soodvisnosti in zakonitosti procesov v okolju (zrak, tla in voda) in vpliva človeka na ekosistem. Poznavanje, razumevanje in sposobnost uporabe inženirskih orodij in znanj za reševanje okoljskih problemov. Razumevanje in uporaba koncepta trajnosti, etičnih in ekonomskih načel pri načrtovanju in vodenju procesov.	<u>Knowledge and Comprehension</u> Understanding of complex correlations between processes in the environment (air, soil and water). Deep understanding of human impacts on ecosystems. Ability to recognise engineering approach as the fundament for realising solutions to a range of environmental issues. Knowledge on sustainable development principles, economic aspects and social responsibility of engineers when designing and operate different processes.
<u>Uporaba</u> Sposobnost kvantifikacije okoljskih problemov in uporaba zakonitosti pri reševanju kompleksnejših inženirskih problemov. Sinteza inženirskih principov in tehnik skupaj z znanjem naravoslovja za iskanje rešitev specifičnih problemov.	<u>Application</u> Ability of quantification of environmental problems and application of natural laws in solving more complex engineering environmental problems. Synthesis of engineering principles and techniques together with knowledge on fundamental environmental principles to solve particular problems
<u>Refleksija</u> Sposobnost prepoznavanja in kvantifikacije okoljskih problemov in vplivov, sposobnost poiskati povezavo med teorijo in problemi v lastni okolici. Razumeti svojo etično	<u>Analysis</u> Ability to recognize and quantify environmental problems and impacts, connect theoretical knowledge and actual local and regional environmental problems. Understand own

odgovornost.	ethical responsibility.
Prenosljive spretnosti Spretnost uporabe domače in tuje literature. Sinteza znanja različnih naravoslovnih področij (kemije, biologije, fizike, tehnike). Razvoj sposobnosti povezati praktične probleme s teoretičnimi znanji. Uporaba ustnega in pisnega načina poročanja. Razvoj sposobnosti dela v skupini.	Skill-transference Ability Ability to search, select and apply different types of literature. Synthesis of different fields of basic science (chemistry, physics, biology, engineering sciences). Ability to connect theoretical and practical approach. Development of oral and literate skills. Development of ability to work in teams.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- Predavanja - Laboratorijske vaje - Strokovna ekskurzija	Lectures Lab courses Field trip

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene obveznosti pri vajah. Pisni izpit.	**25%** **75%**	Accomplished lab course. Written exam

Reference nosilca / Lecturer's references:

KALČÍKOVÁ, Gabriela, ALIČ, Branko, SKALAR, Tina, BUNDSCHUH, Mirco, ŽGAJNAR GOTVAJN, Andreja. Wastewater treatment plant effluents as source of cosmetic polyethylene microbeads to freshwater. *Chemosphere*, ISSN 0045-6535. [Print ed.], Dec. 2017, vol. 188, str. 25-31.

KALČÍKOVÁ, Gabriela, ŽGAJNAR GOTVAJN, Andreja. From dumping to sustainable landfilling : the concept of aerobic landfills. V: JACKSON, Carla H. (ur.). *Landfills and recycling centers : processing systems, impact on the environment and adverse health effects*, (Environmental remediation technologies, regulations and safety). New York: Nova Science Publishers. cop. 2015, str. 199-221.

KALČÍKOVÁ, Gabriela, TRATAR-PIRC, Elizabeta, ŽGAJNAR GOTVAJN, Andreja. Aerobic and anaerobic biodegradation potential of leachate from old active landfill. *Desalination and water treatment*, ISSN 1944-3994. [Print ed.], 2016, vol. 57, iss. 19, str. 8619-8625

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVE POLIMERNEGA INŽENIRSTVA
Course Title:	PRINCIPLES OF POLYMER ENGINEERING

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

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: INSI31

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. Urška Šebenik / Dr. Urška Šebenik, 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 v polimere; - Porazdelitev molekulskih mas in povprečja molekulskih mas; - Stopenjska polimerizacija: mehanizem, izračun molekulskih mas in porazdelitve molekulskih mas za linearne polimere, kinetika stopenjske polimerizacije v homogenih in difuzijsko nekontroliranih sistemih (katalitska reakcija z uporabo zunanjega katalizatorja, avtokatalitska reakcija), tvorba razvejenih in zamreženih polimerov, računski primeri; - Verižna polimerizacija s prostimi radikali: mehanizem, kinetika, kinetična dolžina verige in stopnja polimerizacije, vpliv reakcij prenosa na povprečno stopnjo polimerizacije,	- Introduction to polymers; - Molecular weight distribution and averages; - Step polymerization: mechanism, calculation of average molecular weights and distribution for liner polymers, kinetics in homogeneous and diffusion uncontrolled systems (catalytic reaction with external catalyst, autocatalytic reaction), formation of branched and cross-linked polymers, problems; - Free radical chain polymerization: mechanism, kinetics, kinetic chain length, degree of polymerization, effect of chain transfer reactions on average degree of polymerization, copolymerization, problems; - Emulsion polymerization: principles of

kopolimerizacija, računski primeri; - Emulzijska polimerizacija: osnove emulzijske polimerizacije, Harkinsov mehanizem, kinetika, povprečno število radikalov na delec, računski primeri. - Laboratorijske vaje: Kinetika šaržne polimerizacije vinil acetata v raztopini; Knetika kontinuirne polimerizacije 2-etilheksil akrilata v masi; Kinetika suspenzijske polimerizacije vinil acetata v šaržnem reaktorju; Kinetika emulzijslke polimerizacije vinil acetata v šaržnem reaktorju.	emulsion polymerization, Harkins mechanism, kinetics, average number of radicals per particle, problems. -Laboratory practice: Kinetics of vinyl acetate polymerization in solution in a batch reactor; Kinetics of continuous bulk polymerization of 2-ethylhexsyl acrylate; Kinetics of suspension polymerization of vinyl acetate in a batch reactor; Kinetics of batch emulsion polymerization of vinyl acetate.

Temeljna literatura in viri / Readings:

- A. Kumar in R. K. Gupta, Fundamentals of Polymers, The McGraw-Hill Companies, Inc., New York, 1998, 543 str., (50 %).
- R. O. Ebewele, Polymer Science and Technology, CRC Press, Boca Raton, 2000, 463 str., (25 %).
- U. Šebenik, Osnove polimernega inženirstva: Zbirka nalog, UL FKKT, Ljubljana, 2012, 41 str., (100 %).
-

Dopolnilna literatura:

- Rudin, The Elements of Polymer Science and Engineering, 2nd Ed., Academic Press, London, 1999, 483 str.
- P. Rempp, E. W. Merrill, Polymer synthesis, 2nd Ed., Huthig & Wepf Verlag, Basel, 1991, 336 str.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje osvojijo osnovna znanja iz področja polimernega inženirstva. Študentje pri predmetu pridobijo naslednje specifične kompetence: - poznavanje načinov napovedovanja distribucije molekulskih mas; - poznavanje toplotnih prehodov, specifičnih za polimerne molekule; - poznavanje fizikalnih stanj polimerov in vpliva procesnih parametrov na fizikalna stanja; - poznavanje in kvantitativno ovrednotenje polimerizacijskih procesov; - razumevanje vpliva načina polimerizacije na lastnosti polimernega produkta.	Acquisition of basic knowledge from polymer engineering; Acquisition of knowledge about molecular weight and molecular weight distribution and methods for molecular weight distribution prediction; knowledge about thermal transitions in polymers and the ability to distinguish between different polymer physical states; Acquisition of knowledge about polymerization processes and their quantitative description; Understanding the effect of the type of polymerization and of polymerization process parameters on product properties.
Predvideni študijski rezultati:	**Intended Learning Outcomes:**

Znanje in razumevanje Študent zna kvantitativno obravnavati osnovne polimerizacijske procese in napovedovati ključne lastnosti produkta glede na vrsto in način polimerizacijskega procesa. Razume zvezo med procesnimi parametri in sintetiziranim polimerizacijskim produktom. Zna uporabiti znanja kemijske kinetike in termodinamike na področju sinteze polimerov.	Knowledge and Comprehension Understanding basic principles of polymer engineering science; Ability of quantitative description of basic polymerization processes and resulting polymers; Understanding relationship between process parameters and polymer properties; Ability to employ chemical kinetics and thermodynamics to describe polymerizations.
Uporaba Pridobljena znanja je sposoben uporabiti pri študiju kemijsko inženirskih predmetov, kot tudi pri samostojnem razvojnem in raziskovalnem delu. Sposoben je kvantitativne analize enostavnejših industrijskih polimerizacijskih procesov.	Application At other courses from chemical engineering and at individual research work; Quantitative analysis of relatively simple polymerization processes on industrial level.
Refleksija Študent je sposoben samostojno sklepati, postavljati zaključke ter uporabiti svoje znanje pri sorodnih predmetih. Znanja s področja polimernega inženirstva mu omogočajo razumevanje sorodnih reakcijskih sistemov.	Analysis Ability to apply the acquired knowledge at familiar courses by critical thinking and deduction; Fundamental knowledge enables understanding similar reactive processes.
Prenosljive spretnosti Razvita sposobnost kritičnega razmišljanja in sklepanja. Sposobnost povezovanja osnovnih znanj ter študija domače in tuje literature.	Skill-transference Ability Development of the ability of critical thinking and deduction; Ability of knowledge integration and studying relevant literature from the field of polymer engineering.

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu.		Laboratory practice is a prerequisite to exam attendance
Poročila in zagovor laboratorijskih vaj.	**30**	Written reports and oral laboratory practice defence.
Pisni izpit.	**70**	Written exam.

Reference nosilca / Lecturer's references:

- ŠEBENIK, Urška, KRAJNC, Matjaž. Influence of the soft segment length and content on the synthesis and properties of isocyanate-terminated urethane prepolymers. *Int. j. adhes. adhes.*. [Print ed.], 2007, vol. 27, no. 7, str. 527-535. [COBISS.SI-ID 28640005]
- MOHORIČ, Ines, ŠEBENIK, Urška. Semibatch anionic ring-opening polymerization of octamethylcyclotetrasiloxane in emulsion. *Polymer*, ISSN 0032-3861. [Print ed.], 2011, vol. 52, no. 20, str. 4423-4428. [COBISS.SI-ID 35309317]
- ŠEBENIK, Urška, KRAJNC, Matjaž. Seeded semibatch emulsion copolymerization of

methyl methacrylate and butyl acrylate using polyurethane dispersion : effect of soft segment length on kinetics. *Colloids surf., A Physicochem. eng. asp.*. [Print ed.], 2004, vol. 233, no. 1/3, str. 51-62. [COBISS.SI-ID 25609989]

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.**	**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:

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: doc. 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:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	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
   h. Datoteke

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
   g. Libraries

i. Analiza in vizualizacija podatkov j. Iskanje in popravljanje napak	h. Files (read, write) i. Data analysis and visualization j. Debugging and handling errors

Temeljna literatura in viri / Readings:

A. Sweigart, Automate the Boring Stuff with Python : Practical Programming for Total Beginners, 2015
Zapiski s predavanj, vaje, zgledi in povezave objavljene na spletni strani predmeta. / Lecture notes, excercises, examples and links published on the home page of the course.

Dodatna literatura / Additional literature:
M. Lutz, Learning Python, Fifth Edition, O'Reilly Media, 2013

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

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Poznavanje programske opreme in uporabe algoritmov. Poznavanje osnovnih programskih konstruktov (spremenljivke, stavki, zanke, funkcije, …) in njihova učinkovita uporaba za reševanje programerskih problemov.	Knowledge and Comprehension Knowledge of software tools and algorithms. Knowledge of basic programming constructs (variables, statements, loops, functions, …) and their efficient use to solve programming problems.
Uporaba Snov predmeta predstavlja osnovno poznavanje računalniške tehnologije, ki se kot orodje uporablja na številnih področjih. Znanje programiranja je temelj za boljše razumevanje delovanja računalnika in programskih orodij, ki jih inženir uporablja pri svojem delu.	Application Subject material represents a basic knowledge of computer technology, which is used as a tool in many areas. Programming knowledge is the basis for a better understanding of computer hardware and software tools that engineer uses in his work.
Refleksija Spoznavanje osnov algoritmičnega razmišljanja in kodiranja računalniškega programa.	Analysis 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:	POLIMERNI MATERIALI
Course Title:	POLYMER MATERIALS

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

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: INSI3

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

Nosilec predmeta / Lecturer: prof. dr. Urška Šebenik / Dr. Urška Šebenik, 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):**
- Definicije pojmov monomer, oligomer, polimer, polimerizacija, stopnja polimerizacije, ponavljajoča se enota, zamreženje, kopolimer, kopolimerizacija; - Osnovne vrste polimernih materialov: organski, anorganski, naravni, sintetični - Razvrstitev polimernih materialov glede na vrsto polimerizacije, vrsto ponavljajočih se enot, obliko makromolekul, urejenost polimernih verig, lastnosti pri povišanih temperaturah, proizvodnjo in potrošnjo, področje uporabe in ključne skupne lastnosti za posamezne vrste polimernih materialov; - Glava-rep in glava-glava razporeditev monomernih enot v polimerni verigi,	- Definition of terms monomer, oligomer, polymer, polymerization, degree of polymerization, repeating unit, crosslinking, copolymerization, copolymer; - Basic types of polymer materials: organic, inorganic, natural, synthetic; - Classification of polymer materials regarding kind of polymerization, repeating units, shape of macromolecules, orientation of macromolecules, arrangement of macromolecules, properties at elevated temperature, production and consumption, field of application, and key common properties for specific types of polymer materials; - Head-to-tail and head-to-head distribution of

konfiguracije in konformacije polimerov; - Povprečja molekulskih mas, polidisperznost, določanje molekulskih mas; - Fizikalna stanja in urejenost polimernih verig, kristalinično in amorfno stanje; - Toplotni prehodi: taljenje, steklast prehod, tečenje; - Mehanske lastnosti polimernih materialov; - Uporabnost diferenčne dinamične kalorimetrije in dinamične mehanske analize za karakterizacijo polimernih materialov; - Osnovni stopenjski polimeri z osnovami stopenjske polimerizacije; - Osnovni verižni polimeri z osnovami verižne polimerizacije; - Produkti homogenih in heterogenih polimerizacij; - Polimerni kompoziti, nanokompoziti, zmesi; - Recikliranje in degradacija polimernih materialov, uporaba termogravimetrične analize za karakterizacijo polimernih materialov; - Polimeri s posebnimi lastnostmi, biopolimeri, polimeri iz obnovljivih virov; - Uporaba nuklearne magnetne resonančne spektroskopije, infrardeče spektroskopije in reometrije za karakterizacijo polimernih materialov. - Laboratorijske vaje: Instrumentalne tehnike za karakterizacijo polimernih materialov; Spremljanje stopenjske polimerizacije pri šaržni sintezi nasičenega poliestra; Zamreženje nenasičenega poliestra; Temperatura steklastega prehoda in trdota mehčanega polivinilklorida; Ekstrudiranje plastomerov.	monomer units in polymer chain, polymer configurations and conformations; - Average molecular weights, polydispersity, average molecular weights determination; - Molecular interactions, polymer crystals, amorphous bulk state; - Heat transitions: melting, glass transition, flow; - Mechanical properties of polymer materials; - Differential scanning calorimetry and dynamic mechanical analysis for polymer materials; - Common step polymers with principles of step polymerization; - Common chain polymers with principles of chain polymerization; - Products of homogeneous and heterogeneous polymerizations; - Polymer composites, nanocomposites and blends; - Recycling and degradation of polymer materials, use of thermogravimetric analysis for polymer materials characterization; - Polymers designed for specific use, biopolymers, polymers from renewable resources; - Use of nuclear magnetic resonance spectroscopy, infrared spectroscopy and rheometry for polymer materials characterization; - Laboratory practice: Instrumental techniques for polymer materials characterization; Monitoring synthesis of saturated polyester in a batch reactor; Crosslinking of unsaturated polyester; Glass transition temperature and hardness of softened polyvinylchloride; Extrusion of plastomers.

Temeljna literatura in viri / Readings:

- C. E. Carraher, Jr., Polymer Chemistry: An Introduction, 4th Ed., Marcel Dekker, Inc., New York, 1996, 541 str., (60 %),
- R. O. Ebewele, Polymer Science and Technology, CRC Press, Boca Raton, 2000, 471 str., (20 %).

Dopolnilna literatura:

- C. A. Harper, Handbook of Plastics Technologies, McGraw-Hill, New York, 2006, (loč. pag.).

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje osvojijo osnovna znanja o polimernih materialih in njihovih ključnih lastnostih. Študentje pri predmetu pridobijo naslednje specifične kompetence: - poznavanje fizikalnih stanj in načina urejanja polimernih verig v polimernih materialih ter razumevanje vpliva na lastnosti polimernih materialov; - poznavanje osnovnih vrst polimernih materialov, njihovih specifičnosti in uporabe; - razlikovanje med osnovnimi sintetičnimi polimernimi materiali; - razlikovanje med polimernimi materiali za široko potrošnjo in inženirskimi polimernimi materiali; - poznavanje polimernih materialov s specifičnimi lastnostmi; - razumevanje pomena in prednosti polimernih zmesi, polimernih kompozitov in polimernih nanokompozitov; - poznavanje osnovnih biopolimerov; - poznavanje možnosti ter načinov recikliranja in razgradnje polimerov.	Acquisition of basic knowledge about polymer materials and their properties; Acquisition of knowledge on polymer morphology and polymer structure-property relationships, knowledge about basic polymer materials, key properties and use of basic polymer materials, distinction between basic synthetic polymer materials for common use and engineering polymer materials, polymer materials with specific properties, polymer blends and composites, polymer nanocomposites, biopolymers, polymer recycling and degradation.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pozna osnovne in specifične, znane polimerne materiale in njihove lastnosti ter uporabnost. Lastnosti polimernih materialov zna povezati z njihovo strukturo in fizikalnim stanjem. Razume pomen in prednosti polimernih zmesi, polimernih kompozitov in polimernih nanokompozitov. Pozna osnovne načine recikliranja polimernih materialov.	<u>Knowledge and Comprehension</u> Understanding the basic principles of composition and structure of polymer materials and polymer composites, and understanding the basic principles of the relationship between polymer material properties and their composition and structure.
<u>Uporaba</u> Znanja iz predmeta zna uporabiti pri študiju predmetov s področja polimernega inženirstva in materialov. Študent je sposoben izbirati med različnimi polimernimi materiali za izbrano aplikacijo.	<u>Application</u> Acquired knowledge is necessary for appropriate polymer material selection for a specific application, and for work, research and development in the field of polymer materials and polymer engineering.
<u>Refleksija</u> Študent je sposoben pridobljeno znanje uporabiti pri sorodnih predmetih in na področjih, kjer se polimerni materiali	<u>Analysis</u> Ability to apply knowledge about material properties at familiar courses and/or when a polymer material selection is needed.

uporabljajo.	
Prenosljive spretnosti Razvita sposobnost kritičnega razmišljanja in logičnega sklepanja. Sposobnost študija domače in tuje literature.	Skill-transference Ability Ability of critical thinking and deduction; Ability of studying relevant literature from the field of polymer materials.

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu.		Laboratory practice is a prerequisite to exam attendance
Poročila in zagovor laboratorijskih vaj.	**30**	Written reports and oral laboratory practice defence.
Pisni izpit.	**70**	Written exam.

Reference nosilca / Lecturer's references:

- KAJTNA, Jernej, ŠEBENIK, Urška, KRAJNC, Matjaž. Synthesis and dynamic mechanical analysis of nanocomposite UV crosslinkable 100% solid acrylic pressure sensitive adhesives. *International journal of adhesion and adhesives*, ISSN 0143-7496. [Print ed.], 2014, vol. 49, no. 1, str. 18-25. [COBISS.SI-ID 1663791]
- KRAJNC, Matjaž, KARGER-KOCSIS, József, ŠEBENIK, Urška. Grafting of maleic anhydride onto an ethylene-propylene-diene terpolymer and concurrent organoclay nanocomposite preparation in solution and melt. *Journal of applied polymer science*, ISSN 0021-8995, 2013, vol. 127, no. 2, str. 950-958. [COBISS.SI-ID 35973125]
- MOHORIČ, Ines, ŠEBENIK, Urška. Anionic ring-opening polymerization of octamethylcyclotetrasiloxane in emulsion above critical micelle concentration. *Polymer*, ISSN 0032-3861. [Print ed.], 2011, vol. 52, no. 5, str. 1234-1240. [COBISS.SI-ID 34739717]

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 Kemijsko inženirstvo, 1. stopnja	**/**	**2. ali 3.**	**/**
USP Chemical Egineering, 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: prof. dr. Aleš Podgornik / Dr. Aleš Podgornik, Full Professor

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

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

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

Prerequisites:

The course has to be assigned to the student.

Vsebina:

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:

Content (Syllabus outline):

During practical training student gets experience of complexity of industrial processes control. Understanding of all process operations together with characteristics of raw materials, intermediates, products, material process flow as well as entire process is a prerequisite for safe and efficient process performance. The entire process efficiency can be achieved only by optimisation of each single unit operation finalized by optimal performance of entire process resulting in harmonized operation without bottlenecks. Practical training is adopted to specific process and facility where it is performed. Practical training can be performed on the following types of processes:

- Introduction into the processional work

- uvajanje v delo na poklicnerm 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.	• Get an overview of technology process and routine production process • Contributing to R&D tasks and design of novel products • Supervision of the process • Quality control of raw material and final products • Instrumental analysis in R&D or QC labs • Activities related to environmental and safety issues Maintenance of process, analytical and regulatory equipment

Temeljna literatura in viri / Readings:

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

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.	Objective of practical training is implementation of theoretical knowledge acquired during study and to upgrade it by practical experience typical for specific technology environment and are impossible to be presented during study. Practical training involves company or institution supervisor, and supervisor in faculty and provides insight into specific challenges in laboratories, industrial production and broader.

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	<u>Knowledge and Comprehension</u> During practical training theoretical and practical knowledge acquired different course has to be combined and implemented to particular system e.g. analytical labs, QC labs and industrial facilities. Student is involved in methodology used to solve specific problem, determined key process parameter and working in team.

strokovne komunikacije z drugim člani tima.	
Uporaba Praktično usposabljane 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 Practical training provides to student: capability to transfer theoretical knowledge to solving specific problems using state of the art engineering approaches, getting familiar with team working, practice communications with co-workers and experts from different disciplines enabling active participation in multidisciplinary projects as well as ethical and ecological responsibility.
Refleksija Študent je sposoben kritično analizirati in primerjati različne pristope pri reševanju problemov tako na laboratorijskem kot tudi industrijskem nivoju.	Analysis Student is able to critically asses and compare different approaches used to solve specific problems on laboratory and industrial level.
Prenosljive spretnosti Usposabljanje v konkretnem delovnem okolju mu razvija sposobnost za analitično naravoslovno tehnično vrednotenje dogajanj v praksi.	Skill-transference Ability Practical training in specific working environment provides conditions for analytical evaluation of real processes.

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, ki mora imeti najmanj 7. stopnjo izobrazbe kemijskega inženirstva ali sorodne smeri.	Practical training is performed in a company or other institution. Agreement with company, determining training details and conditions, has to be signed. Company supervisor should have at least 7th education level of chemical engineering or similar discipline.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Dnevnik in poročilo o praksi. Opravljeno /neopravljeno		Pass/fail

Reference nosilca / Lecturer's references:

- Černigoj, Urh, Vidic, Urška, Barut, Miloš, Podgornik, Aleš, Peterka, Matjaž, Štrancar, Aleš. A multimodal histamine ligand for chromatographic purification of plasmid DNA. *J. chromatogr., A*, 2013, vol. 1281, str. 87-93, doi: 10.1016/j.chroma.2013.01.058.
- Lendero Krajnc, Nika, Vidič, Jana, Brne, Peter, Smrekar, Vida, Štrancar, Aleš, Podgornik, Aleš. Characterization of ion exchange stationary phases via pH transition profiles. *J. chromatogr., A*, 2008, vol. 1185, str. 59-70. [COBISS.SI-ID 3442296]
- Junkar, Ita, Koloini, Tine, Krajnc, Peter, Nemec, Damjan, Podgornik, Aleš, Štrancar, Aleš. Pressure drop characteristics of poly(high internal phase emulsion) monoliths. *J. chromatogr., A*, 9 Mar.

2007, vol. 1144, iss. 1, str. 48-54.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ FIZIKE
Course Title:	PHYSICS LABORATORY

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN108

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

Nosilec predmeta / Lecturer: doc. dr. Aleš Mohorič / Dr. Aleš Mohorič, Associate 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:

Sile pri nihanju, Gibalna količina in trki, Vrtenje telesa v tekočini, Stojno valovanje, Določanje gostote zraka pri normalnih pogojih, Kalorimetrija, Električna vezja, Električna kapaciteta, Sila na vodnik v magnetnem polju, Barvna slika, Geometrijska optika, Absorpcija sevanja gama. Uvodno predavanje: predstavitev vaj, opis merskih metod, osnove statistične obdelave podatkov in ocenjevanje napak.

Content (Syllabus outline):

Forces on a pendulum, linear momentum and collisions, rotation of a body in a fluid/viscosity, standing waves, determining air density, Calorimetry, electrical circuits, electrical capacity, magnetic force, color image, geometrical optics, absorption of gamma radiation.
Introductory lecture on: laboratory journal, measurement methods, data processing and error estimation

Temeljna literatura in viri / Readings:

- A. Mohorič, T. Podobnik, Praktikum iz fizike za kemijsko inženirstvo, http://www.fmf.uni-lj.si/~mohoric/praktifizki/praktikumKI_v13.pdf, 33 str. (100 %)

Cilji in kompetence:	**Objectives and Competences:**
Študenti spoznajo osnovne fizikalne merske metode in eksperimentalno opremo, ob samostojni izvedbi meritev nekaterih fizikalnih procesov. Privadijo se kritičnemu ovrednotenju podatkov, analizi le-teh in določitvi merskih napak. Poglobijo znanje o osnovnih fizikalnih procesih in pridobijo izkušnje pri laboratorijskem delu. Predmetno specifične kompetence: pridobitev praktičnega znanja pri laboratorijskem delu, izvedbi fizikalnih meritev in obdelavi podatkov.	Students learn basic physical measurement methods and experimental equipment, the independent execution of measurements of certain physical processes. They get accustomed to critical evaluation of data, its analysis, and determining the measurement errors. Students deepen their knowledge of basic physical processes and gain experience in laboratory work. Subject specific competences: the acquisition of practical skills in laboratory work, carrying out physical measurements and data processing.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> S samostojno izvedbo meritev študenti pridobijo izkušnje pri laboratorijskem delu. Poglobijo znanje nekaterih osnovnih pojavov v fiziki. Spoznajo merske metode, eksperimentalno opremo, pripravo in izvedbo meritev. Naučijo se izvrednotenja merskih napak in vodenja laboratorijskega dnevnika.	<u>Knowledge and Comprehension</u> Through independent experimentation students gain experience in laboratory work, increase their knowledge of some basic phenomena in physics, learn about experimental methods, experimental equipment, preparation and execution of the experiment. They also learn how to evaluate measurement errors and keep a laboratory journal.
<u>Uporaba</u> Uporaba eksperimentalne opreme; uporaba sodobnih načinov obdelave podatkov; kritično vrednotenje pridobljenih podatkov na podlagi ocene merskih napak.	<u>Application</u> Use of experimental equipment, modern data processing tools, critical data evaluation based on measurement uncertainty.
<u>Refleksija</u> Kritična primerjava eksperimentalnih rezultatov s teoretičnimi modeli. Preverjanje fizikalnih zakonov z lastnimi izkušnjami.	<u>Analysis</u> Critical evaluation of theoretical model with experimental results. Test physics laws with personal experience.
<u>Prenosljive spretnosti</u> Uporaba merilnih instrumentov. Uporaba metod analize in obdelave podatkov.	<u>Skill-transference Ability</u> Use of measurement instruments. Use of data analysis and processing methods.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Seminar s pojasnili o merskih metodah, sodobni analizi podatkov in izvrednotenju napak. Laboratorijske vaje: izvedba meritev, analiza podatkov in izvrednotenje rezultatov.	Introductory lecture on experimental methods, modern data analysis and error estimation. Laboratory exercises: executed in pairs, data analysis, results evaluation and keeping the laboratory journal.

Delež (v %) /

Načini ocenjevanja:	Weight (in %)	**Assessment:**
Pisni izpit po uspešno opravljenem praktičnem delu.		Written examination after successful completion of practical work

Reference nosilca / Lecturer's references:

1. STEPIŠNIK, Janez, LAHAJNAR, Gojmir, ZUPANČIČ, Ivan, MOHORIČ, Aleš. Study of translational dynamics in molten polymer by variation of gradient pulse-width of PGSE. Journal of magnetic resonance, ISSN 1090-7807, 2013, vol. 236, str. 41-46, doi: 10.1016/j.jmr.2013.08.003. [COBISS.SI-ID 27404327]
2. STEPIŠNIK, Janez, FRITZINGER, Bernd, SCHELER, Ulrich, MOHORIČ, Aleš. Self-diffusion in nanopores studied by the NMR pulse gradient spin echo. Europhysics letters, ISSN 0295-5075, 2012, vol. 98, no. 5, str. 57009-p1-57009-p4. http://iopscience.iop.org/0295-5075/98/5/57009. [COBISS.SI-ID 2434404]
3. STEPIŠNIK, Janez, MOHORIČ, Aleš, SERŠA, Igor, LAHAJNAR, Gojmir. Analysis of polymer dynamics by NMR modulated gradient spin echo. V: VOLOVŠEK, Vesna (ur.), BISTRIÈIAE, Lahorija (ur.). Polymer spectroscopy July 2011, (Macromolecular Symposia, ISSN 1022-1360, Special issue, Volume 305, Issue 1). Basel [etc.]: Hüting & Wepf Verlag, 2011, vol. 305, str. 55-62, doi: 10.1002/masy.201000120. [COBISS.SI-ID 2362212]

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

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN116

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

Nosilec predmeta / Lecturer: prof. dr. Matevž Pompe /
Dr. Matevž Pompe, 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):**
Študent bo samostojno pripravil, izvedel, predstavil in zagovarjal med 10 do 15 praktičnih laboratorijskih vaj. Vaje bodo pokrivala naslednja področja: Titrimetrična analiza (nevtralizacijske, obarjalne, redoks in kompleksometrične titracije)- z uporabo potenciometrične indikacije Amperometrična titracija Potenciometrično ugotavljanje ekvivalentne točke – različni titratorji Merjenje pH, uporaba ionoselektivnih elektrod Molekulska spektrometrija Plamenska spektrometrija Atomska emisijska in absorpcijska	Students will independently prepare, perform, present and defend from 10 to 15 practical laboratory exercises. The exercises to be carried will cover the following areas: Volumetric analysis (neutralization, precipitation, redox and complexometric titration) with potentiometric indication. Amperometric titration Potentiometric determination of equivalence point – various titrators. Measurements of pH, application of ion-selective electrodes. Flame spectrometry. Atomic emission and absorption spectrometry. IR spectrometry. Separation methods: ion-exchange, thin-layer

spektrometrija IR spektrometrija Separacijske metode: ionska izmenjava, Plinska kromatografija za določanje različnih hlapnih spojin. Tekočinska kromatografija Masna spektrometrija Priprava vzorca za določanje spojin z GC, HPLC	chromatography. Gas-chromatography for determination of various volatile compounds. Liquid-chromatography Mass spectrometry Sample preparation for HPLC or GC analysis

Temeljna literatura in viri / Readings:

D. Kočar, P. Kralj, M. Pompe, Praktikum iz instrumentalnih metod analize, navodila za vaje, 64 strani.

Cilji in kompetence:	**Objectives and Competences:**
Generične kompetence: študent bo pridobil zmožnost uporabe pridobljenega znanja v praksi; sposobnost pridobivanja različnih informacij; zmožnost prilagoditve različnim situacijam; reševanje različnih problemov; delovanje v skupini in samostojno. **Kemijske kompetence:** sposobnost razumevanja osnovnih dejstev; sposobnost opazovanja različnih pojavov; sposobnost razreševanja (kvalitativno in kvantitativno) konkretnih kemijskih problemov; sposobnost predstavitve določenih rezultatov ustno in v pismeni obliki; občutek za oceno rezultatov. **Praktična znanja:** pravilno izvajanje različnih kemijskih poskusov in enostavnih laboratorijskih opravil; pravilna izvedba meritev različnih kemijskih veličin; pravilno ovrednotenje različnih meritev in jih povezati z različnimi teorijami; vodenje laboratorijskega dnevnika.	**Generic competences:** Students will gain the opportunity to use the acquired knowledge in practice, the ability to obtain a variety of information, ability to adjust to different situations, solve various problems in a group and individually. **Chemical competences:** gain competence to understand the basic facts, to observe various phenomena, to solve (qualitatively and quantitatively) various chemical problems, to present results orally and in written form, to critically evaluate results. **Practical knowledge:** to correctly perform various experiment and simple laboratory procedures, to measure various chemical quantities, to correctly evaluate various measurements and connect them to various theories, to write laboratory notebook.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študenti bodo nadgradili osnovna praktična kemijska znanja za nadaljevanje študija kemijskega inženirstva. Študent/ka pridobi veščine in zmožnost dela v kemijskem laboratoriju.	Knowledge and Comprehension Students will upgrade their basic practical chemical knowledge necessary for study of chemical engineering. Students will gain skills and the ability to work in a chemical laboratory.

Uporaba Pridobljene spretnosti pri laboratorijskem eksperimentalnem delu so splošno uporabne za delo pri vseh drugih laboratorijskih vajah in drugod. Študent se nauči pisanja poročil in vodenja laboratorijskega dnevnika.	Application Acquired skills in laboratory experimental work are generally useful at other experimental courses and elsewhere. The students will learn to write reports and laboratory notebooks.
Refleksija Študenta pri konkretnem laboratorijskem delu naučimo povezovanja in razumevanja teorije in prakse. Študent je tudi sposoben kritično ovrednotiti izvedene meritve in dobljene rezultate ter pridobi določen občutek za znanstveno-raziskovalno delo.	Analysis Students will learn on particular laboratory example how to understand and connect theoretical knowledge and practice. The students are capable of critical evaluation of the performed analysis and obtained results as well as they gain basic feeling for scientific research work.
Prenosljive spretnosti Poleg pridobljene spretnosti pri laboratorijskem delu, bo študent pridobil znanje kritičnega ocenjevanje dobljenih rezultatov.	Skill-transference Ability Besides gaining skill for laboratory work, the student will be able to critically evaluate obtained results.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Praktične vaje potekajo v ustrezno opremljenem kemijskem laboratoriju. Pred vajami so krajša navodila v obliki seminarja. Praktične vaje študenti individualno opravljajo v laboratoriju v skupinah po 10 študentov.	Practical exercises are carried out in appropriately equipped laboratory. Students obtain instructions during the seminar. Students prepare seminar exercise based on particular analytical problem.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit.	**50%**	Written exam.
Seminarska naloga.	**25%**	Seminar
Ocenjena poročila laboratorijskih vaj	**25%**	Graded laboratory exercise reports

Reference nosilca / Lecturer's references:

1. 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.
2. 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.
3. 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:	PRAKTIKUM IZ KEMIJSKEGA INŽENIRSTVA
Course Title:	PRACTICAL COURSE IN CHEMICAL ENGINEERING

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN135

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

Nosilec predmeta / Lecturer: izr. prof. dr. Andreja Žgajnar Gotvajn /
Dr. Andreja Žgajnar Gotvajn, Associate 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:

Praktikum vključuje projektno eksperimentalno in seminarsko delo v skupinah (načrtovanje posameznih stopenj procesa do končne karakterizacije produkta), katerega teoretične osnove sodijo na naslednja temeljna področja: mehanika fluidov, prenos toplote in snovi, kemijsko reakcijsko inženirstvo, kemijsko inženirska termodinamika, separacijski procesi, produktno inženirstvo, materiali in karakterizacija materialov.

Content (Syllabus outline):

Students in groups design a specific chemical engineering process at a laboratory scale (from planning individual steps of the process to final product characterisation). Theoretical knowledge of Fluid Mechanics, Heat and Mass transfer, Chemical Reaction Engineering, Chemical reaction Thermodynamics, Separation processes, Product Engineering, Material Sciences and Material Characterisation is implemented in selected case studies and experiments.

Temeljna literatura in viri / Readings:

Literatura, ki je navedena pri predmetih: Mehanika fluidov, Instrumentalne metode, Materiali za inženirje, Kemijska procesna varnost, Prenos toplote in snovi, Kemijsko reakcijsko inženirstvo, Kemijsko inženirska termodinamika, Separacijski procesi in Kemijsko produktno inženirstvo..

Cilji in kompetence:

Cilj:
Študentje s pomočjo laboratorijskega praktičnega dela uporabijo osvojena teoretična znanja in v praksi spoznajo delovanje naprav v kemijskem inženirstvu ter potek in vodenje procesov za namen pridobivanja oz. sinteze želenega produkta. Naučijo se uporabljati in osvojijo potrebne instrumentalne in druge karakterizacijske tehnike oz. metode. Dobljene rezultate z uporabo modernih programskih paketov kvantitativno obravnavajo v skladu s teoretičnimi napovedmi.

Specifične kompetence:
Sposobnost vodenja in nadzora procesov v kemijskem inženirstvu, uporabe laboratorijskih naprav, instrumentalnih metod in programskih paketov, uporaba znanj s področja kemijskega inženirstva (fluidna mehanika, prenos toplote in snovi, kemijsko reakcijsko inženirstvo, kemijska inženirska termodinamike, separacijski procesi, produktno inženirstvo, inženirstvo materialov, karakterizacija materialov, kemijska procesna varnost)

Objectives and Competences:

Learning outcomes.
Ability to implement theoretical knowledge from all engineering topics through experimental work; To become familiar with chemical engineering processes in practice and with proper design procedures incorporating sophisticated computer software; To be able to use modern instrumentation techniques in process control and to use modern characterisation method of final products; To interpret final experimental results in consistency with theoretical predictions.

Competences:
To handle chemical engineering apparatus at all scales, to use instrumentation methods and computer software; To effectively use all chemical engineering knowledge (Fluid Mechanics, Heat and Mass Transfer, Chemical Reaction Engineering, Chemical Reaction Thermodynamic, Separation processes, Product Engineering, Material Sciences and Material Characterisation) in design and control of chemical engineering processes in consistency with chemical engineering process safety rules.

Predvideni študijski rezultati:

Znanje in razumevanje
Študent je sposoben prepoznati vlogo in razumeti pomen poznavanja osnovnih kemijsko inženirskih znanj za vodenje specifičnih procesov in za načrtovanje naprav in produktov.

Intended Learning Outcomes:

Knowledge and Comprehension
Students will acquire the understanding and skills to handle chemical engineering apparatus at laboratory scale, to use instrumentation methods and computer software.

Uporaba Pridobljena praktična znanja in znanje interpretiranja ter obdelovanja eksperimentalnih podatkov je sposoben uporabiti pri razvojnem in raziskovalnem delu na različnih področjih kemijskega inženirstva.	Application Students gain practical knowledge of chemical engineering theories.
Refleksija Študent je sposoben istočasno uporabiti pridobljena kemijsko inženirska znanja in poznavanje različnih metod za nadzor procesa in karakterizacijo produkta pri reševanju specifičnih praktičnih problemov.	Analysis Student is capable to apply chemical engineering's fundamental theories in a lab setting, running real chemical operations.
Prenosljive spretnosti Razvita sposobnost uporabe teoretičnega znanja pri praktičnih oz. laboratorijskih eksperimentih. Razvita sposobnost opravljanja laboratorijskih poskusov, vrednotenja in interpretiranja eksperimentalnih rezultatov z uporabo sodobne programske opreme na osnovi osvojenih teoretičnih znanj. Razvita sposobnost kritičnega razmišljanja in logičnega sklepanja. Sposobnost predstavitve rezultatov. Sposoben je skupinskega dela, vodenja skupine in kritično presojati in ocenjevati uspešnost projekta.	Skill-transference Ability Identification and solving of problems. Experimental data collection, analysis and critical evaluation of results.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Projektno delo, ki vključuje laboratorijske vaje in seminar.	Seminars, Practicals.

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

Reference nosilca / Lecturer's references:

- ŽGAJNAR GOTVAJN, Andreja, BISTAN, Mirjana, TIŠLER, Tatjana, ENGLANDE, A. J., ZAGORC-KONČAN, Jana. The relevance of bisphenol A adsorption during Fenton's oxidation. *International journal of environmental science and technology*, ISSN 1735-1472, 2013, vol. 10, no. 6, str. 1141-1148.
- KALČÍKOVÁ, Gabriela, ZAGORC-KONČAN, Jana, ŽNIDARŠIČ PLAZL, Polona, ŽGAJNAR GOTVAJN, Andreja. Assessment of environmental impact of pyridinium-based ionic liquid. *Fresenius environmental bulletin*, ISSN 1018-4619, 012, vol. 21, no. 8b, str. 2320-2325.
- ŽGAJNAR GOTVAJN, Andreja, KALČÍKOVÁ, Gabriela, ZAGORC-KONČAN, Jana. Reduction of

environmental impact of municipal landfill leachate during oxidative treatment : the importance of phytotoxicity assessment. V: CABRAL, Gustavo B. C. (ur.), BOTELHO, Beatriz A. E. (ur.). *Landfills : waste management, regional practices and environmental impact*, (Waste and waste management). New York: Nova Science, cop. 2012, str. 223-251.
- LAKOTA, Ana, LINEC, Mitja, LUBEJ, Martin, PAVKO, Aleksander. *Praktikum iz kemijskega inženirstva*, UL, Fakulteta za kemijo in kemijsko tehnologijo, 2017 (100%)

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ MATERIALOV
Course Title:	PRACTICAL COURSE IN MATERIALS CHARACTERIZATION

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

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: INSI33

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

Nosilec predmeta / Lecturer: izr. prof. dr. Marjan Marinšek / Dr. Marjan Marinšek, Associate 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:

Predmet se izvaja kot laboratorijske vaje, podprte s seminarskimi vajami. Praktične vaje vključujejo projektno delo, teoretično in eksperimentalno, v skupinah na specifični tematiki – materialu s ciljanimi lastnostmi: od načrtovanja in sinteze materiala do končne karakterizacije produkta.
V prvem sklopu študentje zberejo potrebne informacije za načrtovanje sestave, strukture in postopka sinteze specifičnega produkta s ciljanimi lastnostmi. Identificirajo uporabne tehnike in metode za spremljanje poteka sinteze in za določanje lastnosti produkta.
V drugem sklopu študentje sintetizirajo produkt. Spremljajo kinetiko sinteze ter vpliv

Content (Syllabus outline):

The course implements laboratory work, supported by seminar exercises. Practical course includes project team work, both theoretical and experimental. Students in groups design a specific material with desired properties. Material design includes planning, synthesis, and product characterisation.
Project starts with literature survey regarding composition, structure and synthesis route of a desired product. Students specify methods of controlling the synthesis progress and characterization techniques of products.
Project continues with experimental laboratory work. Students follow kinetic aspects of synthesis and effects of synthesis parameters

procesnih parametrov na strukturo in lastnosti materiala. V tretjem sklopu študentje interpretirajo dobljene rezultate ter razložijo vplive sestave, procesa sinteze in strukture materiala na uporabne lastnosti materiala.	on structural and functional properties of products. Finally, students analyse the obtained results and interpret functional and structural properties of the obtained products with regard to process parameters during the synthesis.

Temeljna literatura in viri / Readings:

1. R. O. Ebewele, Polymer Science and Technology, CRC Press, Boca Raton, 2000, 463 str., (50 %).
2. K. Friedrich, S. Fakirov, Z. Zhang, Polymer composites : from nano-to-macro-scale. Springer, New York, 2005, 341 strani. (20%)
3. Zhang s., Li L., Kumar A, Materials Characterization Techniques, CRC Press, London, 2009, 328 strani. (50%)
4. Kaufman E. N., Characterization of Materials 1&2, A John Wiley and Sons Publication, New Jersey, 2003, 1392 strani. (30%)

Cilji in kompetence:	**Objectives and Competences:**
Namen predmeta je, da v prvem delu študnetje pridobijo znanja za računsko obravnavo problemov s področja materialov, v smislu razumevanja njihove zgradbe v povezavi z lastnostmi (mehanskimi, termičnimi električnimi..) na mikro in makro nivoju. V drugem delu pa z laboratorijskim praktičnim delom pridobijo znanja o metodah karakterizacije materialov. Rezultate praktičnih meritev obdelajo in obrazložijo v skladu s teoretičnimi napovedmi. Znanje naj omogoči razumevanje in dialog inženirja s strokovnjaki drugih profilov v praksi in sodobni interdisciplinarni pristop k reševanju nalog.	The purpose of this course is that in the first part, students acquire skills for computational problem solving in the field of materials. in terms of understanding their structure in relation with properties (mechanical, thermal, electrical ...) at the micro and macro level. The goal of the second part of the laboratory practical work is to gain knowledge about the methods of characterization of materials. The students learn to process and explain results of practical measurement in accordance with theoretical predictions. They learn to communicate with experts from other fields in practice and contemporary interdisciplinary approach to problem solving.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študentje spoznajo soodvisnost med zgradbo in lastnostmi materialov. V tečaju bomo podali znanja o metodah karakterizacije materialov ter jih praktično izvedli. Študent pridobi praktično zanje o računski obravnavi primerov s področja razumevanja strukture in sprememb na mikro in makro nivoju.	<u>Knowledge and Comprehension</u> Students learn relationships between structure and material properties. The course will cover knowledge of characterization methods and practical application. Students acquire knowledge of computational problem solving of cases regarding structure and changes at the macro and micro level.

Uporaba Pridobljena znanja je sposoben uporabljati za samostojno, logično in kritično razmišljanje o lastnostih, načrtovanju, izbiri in uporabi različnih materialov.	Application Knowledge is applied independently using logical and critical thinking about characteristics, planning, choice and use of different materials.
Refleksija Laboratorijske vaje in računanje primerov so vezane na vsebine premeta, ki obravnava materiale, njihovo načrtovanje, uporabo in njihov propad. Zaradi svoji interdisciplinarnosti so ve zane tudi na osnovna znanja Fizike, Kemije (anorganske, organske, fizikalne)	Analysis Practical course and computation depends on course curriculum addressing the development of materials, use, decomposition. Due to interdisciplinary properties of the course, knowledge of Physics, Chemistry (inorganic, organic, physical) is required.
Prenosljive spretnosti Sposobnost uporabe principov vede o materialih pri njihovi karakterizaciji in vrednotenju njihovih lastnosti tako pri raziskovanlem kot razvojnem delu.	Skill-transference Ability Ability to use principles of material science. Ability to evaluate material characteristics in research and development.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- Seminarske in laboratorijske vaje - Skupinsko projektno delo	- Solving computational problems, - practical course, - individual seminar work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ustni izpit Opravljeno projektno delo je pogoj za pristop k izpitu.	**100 %**	Oral exam Accomplished project work is a prerequisites to exam attendance.

Reference nosilca / Lecturer's references:

1. JAPIĆ, Dajana, DJERDJ, Igor, **MARINŠEK, Marjan**, CRNJAK OREL, Zorica. In situ and ex situ TEOS coating of ZnO nanoparticles and the preparation of composite ZnO/PMMA for UV-VIS absorbers. Acta chimica slovenica, 2014, vol. 60, no. 4, str. 797-806
2. JAPIĆ, Dajana, PARAMO, Jorge Antonio, **MARINŠEK, Marjan**, STRZHEMECHNY, Yuri M., CRNJAK OREL, Zorica. Growth-morphology-luminescence correlation in ZnO-containing nanostructures synthesized in different media. Journal of luminescence, 2012, vol. 132, iss. 6, str. 1589-1596
3. RAZPOTNIK, Tanja, **MARINŠEK, Marjan**, NOVOSEL, Barbara, ZUPAN, Klementina, FRANCETIČ, Vojmir, MAČEK, Jadran. A polymer complex solution process for the synthesis and characterization of Ni-YSZ cermet material. Ceramics international, 2008, vol. 34, no. 7, str. 1741-1746

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

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN110

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

Nosilec predmeta / Lecturer: doc. dr. Andrej Pevec / Dr. Andrej Pevec, Assistant 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):**
Na seminarskih vajah se z računskimi vajami utrjuje znanje kemijskega računanja, potrebnega za izvedbo posameznih laboratorijskih vaj: osnovni kemijski zakoni, množina snovi, molska masa snovi, formule spojin, kemijske reakcije, parcialni tlaki, množinski deleži, masni deleži, prostorninski deleži, povprečne molske mase, koncentracije raztopin ter računanje pri titracijah, topnosti snovi, kemijskem ravnotežju, protolitskih ravnotežjih in redoks reakcijah. Laboratorijske vaje pokrivajo vsebine: izparevanje, filtracija, sušenje, sinteza preprostih spojin, merjenje prostornine plinov in tekočin, priprava raztopin, merjenje gostote	Seminars cover the basic knowledge needed to accomplish individual experimental problems: basic chemical laws, mole concept and its use in chemical calculations, composition of chemical compounds, chemical formula, chemical reaction and chemical equation, stoichiometry, determination of limiting reactant, gas laws, solutions and their concentrations, solubility, acids and bases (titration), chemical equilibrium, protolitic reactions and redox reactions. Practical courses contain the experimental problems during which the basic laboratory techniques are used (i.e. filtration, evaporation, synthesis of simple compounds, volumetric

tekočin, titracije kislin/baz in redoks titracije.	measurements, working with liquids, density measurements, acid-base titrations, redox titrations).

Temeljna literatura in viri / Readings:

1. L. Golič, I. Leban, P. Šegedin in J. Šiftar: Vaje iz splošne in anorganske kemije- Navodila za vaje, DZS, 1995.
2. N. Bukovec, R. Cerc Korošec, A. Golobič, N. Lah in E. Tratar Pirc: Osnove kemijskega računanja – Zbirka nalog, Univerza v Ljubljani, Fakulteta za kemijo in kemijsko tehnologijo, 2011.
3. J. Brenčič in F. Lazarini, Splošna in anorganska kemija -učbenik, Univerza v Ljubljani, Fakulteta za kemijo in kemijsko tehnologijo.

Cilji in kompetence:	**Objectives and Competences:**
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 eksperimente; so sposobni kritično ovrednotiti določene meritve in/ ali dobljene rezultate pri kemijskem računanju.	Objectives: To provide the students with a general introduction to chemistry in the laboratory as it applies to the subjects mentioned in the course description. To train students in safe, accurate work and standard laboratory procedures. Competences: Ability to properly handle chemicals and laboratory equipment, and to properly act in case of an accident. Being able of independent laboratory work: to employ and make measurements and to critically judge the experimental data and results.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent osvoji osnovno praktično znanje varnega dela v kemijskem laboratoriju ter zna osnove kemijskega računanja uporabiti pri kvantitativnem vrednotenju določenih eksperimentov.	<u>Knowledge and Comprehension</u> Knowledge of basic chemical concepts and their application in chemical calculations. Practical skills for laboratory work including knowledge of laboratory safety rules and knowledge of basic experimental techniques.
<u>Uporaba</u> Pridobljeno znanje oziroma spretnosti pri laboratorijskem delu ter znanje postopkov in pristopov pri reševanju nalog pri kemijskem so temelji predmetom pri nadaljnjem študiju.	<u>Application</u> The practical laboratory skills are necessary firm basis for higher chemistry subjects.

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 povezovanje teorije in prakse.	Analysis Students are provided with the safe laboratory work. Experimental work promote procedural and manipulative skills, observation skills, skills of representing and interpreting data and the accompanying conceptual and critical abilities.
Prenosljive spretnosti Študent pridobi praktične laboratorijske spretnosti in izkušnje, znanje kemijskega računanja ter, zna uporabljati strokovni jezik (pisno in ustno).	Skill-transference Ability The obtained knowledge helps students in designing new experiments, to critically judge the results and to present them in appropriate way.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Sodelovalno učenje/ poučevanje na seminarjih. Sprotno preverjanje znanja na vsakem seminarju oziroma vaji. Pisni pregledni kolokviji ob zaključku določene vsebinske teme predmeta. Laboratorijske vaje, zasnovane na individualnem delu študenta ter delno s timskim delom. Pisanje laboratorijskega dnevnika.	Seminars and practical laboratory exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu.	**20 %**	Laboratory coursework.
Pisni izpit, ki ga lahko nadomestita dva dva kolokvija.	**80 %**	Final written exam (or two partial written tests).

Reference nosilca / Lecturer's references:

1. **Andrej Pevec**, Alojz Demšar, Jiri Pinkas, Marek Necas: Synthesis of Organotitanium(IV) Fluoride Phosphates and the Crystal Structure of [(C5Me4Et)TiF(μ-F){μ-O2P(OSiMe3)2}]2, Acta Chim. Slov. 2012, 59, 203-206.
2. **Andrej Pevec**, Martina Tekavec, Alojz Demšar: Cation-anion interactions involving hydrogen bonds: Syntheses and crystal structures study of hexafluorotitanate(IV) salts with pyridine and methyl substituted pyridines, Polyhedron 2011, 30, 549-555.
3. **Andrej Pevec**, Alojz Demšar: The variations in hydrogen bonding in hexafluorosilicate salts of protonated methyl substituted pyridines and tetramethylethylenediamine, Journal of Fluorine Chemistry 2008, 129, 707-712.
4. **Andrej Pevec**, Alojz Demšar, Jiri Pinkas, Merek Necas: Synthesis, spectroscopic and X-ray characterization of new molecular organotitanium(IV) phosphonate, Inorganic Chemistry Communications 2008, 11, 5-7.
5. Syntheses and Solid-State and Solution Structures of [Ba{(C5Me5)2Ti2F7}2(hmpa)] and [Ba8Ti6F30I2(C5Me5)6(hmpa)6][I3]2, Inorg. Chem. 2004, 43, 1250-1256.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRENOS TOPLOTE IN SNOVI
Course Title:	HEAT AND MASS TRANSFER

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN130

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:

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

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Temeljna vsebinska področja predmeta so:
- mehanizmi prenosa toplote;
- stacionarno in nestacionarno prevajanje toplote;
- prenos toplote s konvekcijo;
- korelacije za prenos toplote;
- prenos toplote pri vretju in kondenzaciji;
- toplotni menjalniki;
- prenos toplote s sevanjem;
- Fickov zakon;
- aplikacije in pomen prenosa snovi;
- primerjava Fickovega zakona z Newtonovim in Fourierjevim zakonom;
- Fickov 2. zakon;
- difuzija v razredčenih in koncentriranih raztopinah;

Content (Syllabus outline):

Mechanisms of heat transfer; Steady-state and unsteady-state conduction; Convective heat transfer; Heat transfer correlations; Heat transfer during boiling and condensation; Heat exchangers; Heat transfer by radiation; Fick's law; Applications and importance of mass transfer; Comparison of Fick's law, Newton law and Fourier law. Fick's 2nd law; Diffusion in diluted and concentrated solutions; Diffusion coefficients; Convective mass transfer; Mass transfer between phases; Mass transfer correlations; Reynolds and Chilton-Colburn analogy for mass, heat and momentum transfer in turbulent flow; Film and penetration theory of mass transfer; Simultaneous heat, mass and

- difuzijski koeficienti; - konvektivni prenos snovi (koeficienti snovnega prenosa in prehoda); - prenos snovi med fazami; - korelacije, ki vključujejo koeficiente snovnega prestopa; - Reynoldsova in Chilton-Colburnova analogija za prenos snovi, toplote in gibalne količine v turbulentnem toku; - filmska in penetracijska teorija snovnega prestopa; - simultani prenos snovi, toplote in gibalne količine.	momentum transfers.

Temeljna literatura in viri / Readings:

- T. Koloini, Prenos toplote in snovi, Založba FKKT, Univerza v Ljubljani, Ljubljana, 1999, 270 str., (80 %).
- E. L. Cussler, Diffusion: Mass Transfer in Fluid Systems, 2. izdaja, Cambridge University Press, Cambridge, 1997, 529 str. (50 %)

Dopolnilna literatura:

- F. P. Incropera, D. P. DeWitt, T. L. Bergman, A. S. Lavine, Fundamentals of Heat and Mass Transfer, 6. izdaja, Wiley and Sons, Inc., New York, 2007, 917 str.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje osvojijo osnovne zakonitosti prenosa toplote in snovi. Študentje pri predmetu pridobijo naslednje specifične kompetence: - poznavanje načinov prenosa toplote in snovi; - razumevanje pomena prenosa toplote in snovi v kemijsko inženirskih aplikacijah; - uporaba zakonitosti prenosa toplote in snovi pri načrtovanju naprav; - povezovanje predhodno osvojenih znanj hidromehanike in termodinamike z znanji prenosa snovi in toplote.	Acquisition of knowledge about the meaning of heat and mass transfer; Understanding the importance of heat and mass transfer phenomena in chemical engineering applications; Ability to implement heat and mass transfer rules in process equipment design; Ability of integrating the knowledge about hydrodynamics, thermodynamics and heat and mass transfer phenomena.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent zna kvantitativno obravnavati osnovne načine prenosa toplote in snovi, razume zvezo med procesnimi spremenljivkami, zna uporabiti matematične zveza za opis procesa.	<u>Knowledge and Comprehension</u> Understanding the basic principles of heat and mass transfer phenomena.

Uporaba Pridobljena znanja je sposoben uporabiti pri študiju kemijsko inženirskih predmetov, kot tudi pri samostojnem razvojnem in raziskovalnem delu. Sposoben je kvantitativne analize prenosa toplote in snovi v reakcijskih in separacijskih procesih.	Application Student is able to apply the knowledge at studying of chemical engineering courses, and at independent research and development work. Student is able to quantitatively analyse heat and mass transfer in reaction and separation processes.
Refleksija Študent je sposoben samostojno sklepati, postavljati zaključke ter uporabiti svoje znanje pri sorodnih predmetih. Znanja s področja prenosa toplote in snovi mu omogočajo razumevanje temeljnih vsebin v kemijsko inženirski znanosti.	Analysis Development of abilities of autonomous deducting, problem defining, problem solving, and coming to conclusions. Knowledge from the field of heat and mass transfer offers understanding of fundamental concepts in chemical engineering science.
Prenosljive spretnosti Razvita sposobnost kritičnega razmišljanja in sklepanja, osvojena sposobnost matematičnega zapisa kemijsko inženirskih problemov, njihove rešitve in verifikacije. Sposobnost povezovanja osnovnih znanj ter študija domače in tuje literature.	Skill-transference Ability Ability of critical thinking and deduction; Acquired skill of mathematical description of chemical engineering problems, their solution and verification. Ability of connecting basic knowledge and study of literature.

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

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

Reference nosilca / Lecturer's references:

- LIKOZAR, Blaž, KRAJNC, Matjaž. A study of heat transfer during molding of elastomers. *Chemical Engineering Science*, ISSN 0009-2509. [Print ed.], 2008, vol. 63, no. 12, str. 3181-3192. [COBISS.SI-ID 29461253]
- 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]
- HACE, Iztok, GOLOB, Janvit, KRAJNC, Matjaž. Kinetics and modelling of the diffusion-controlled diallyl terephthalate polymerization. *Polymer engineering and science*, ISSN 0032-3888, 2004, vol. 44, no. 10, str. 2005-2018. [COBISS.SI-ID 26238469]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SEPARACIJSKI PROCESI
Course Title:	SEPARATION PROCESSES

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

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	IN134

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

Nosilec predmeta / Lecturer:	izr. prof. dr. Aleš Podgornik / Dr. Aleš Podgornik, 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):**
Razumevanje termodinamskih zakonov štirih osnovnih dvofaznih sistemov, ki nastopajo v industriji: trdno-plin, tekoče-plin (para), tekoče-tekoče in tekoče-trdno. Razumevanje osnovnih mehanizmov prenosa snovi med dvema fazama: stacionarna difuzija, stacionarna difuzija s kemijsko reakcijo, ekvimolarna protidifuzija, nestacionarna difuzija v polneskončni medij in nestacionarna difuzija v medij končnih dimenzij. Kvantitativna obravnava snovnih tokov med fazama. Zapis masnih in toplotnih bilanc. Koncept diferencialnega in stopenjskega kontakta. Obravnava tipičnih predstavnikov ravnotežij in specifičnih snovnih transportov v dvofaznih	Understanding the thermodynamic laws of four basic two-phase systems which can be found in industry: solid-gas, liquid-gas (vapour), liquid-liquid and liquid-solid. Understanding the fundamental mechanisms of mass transfer between two phases: stationary diffusion, stationary diffusion with a chemical reaction, equimolar counter-diffusion, transient diffusion into a half-infinite medium and transient diffusion into a medium of finite dimensions. Ability to formulate mass and energy balances. Learning about typical equilibrium cases and specific mass transports in two-phase systems: drying, distillation, absorption, extraction, crystallization and other selected classical

sistemih : sušenje, destilacija, absorbcija, ekstrakcija, kristalizacija ter ostalih izbranih klasičnih in novejših separacijskih procesov kot: membranske separacije, adsorpcija, visokotlačne tehnologije. Obravnava enostavnih in kompleksnih neidealnih večkomponentnih separacijskih sistemov. Izračuni dimenzij aparatov za dano kapaciteto oziroma pri dani kapaciteti izračun dimenzij. V nadgradnji znanj termodinamike in transportnih pojavov določitev potrebnega časa za separacijo in s kombinacijo potrebnega časa snovnega transporta med fazama in masne bilance utrjevanje osvojenega znanja z računanjem dimenzij separatorjev.	processes and some novel separation processes such as: membrane separations, adsorption, high-pressure technologies. Learning about simple as well as complex multicomponent separation systems. Dimensioning of equipment for target production capacity using mass balances. By upgrading thermodynamic and transport phenomena knowledge for calculation of required separation time.

Temeljna literatura in viri / Readings:

- J. D. Seader, E. J. Henley, Separation Process Principles, Second Edition, John Wiley & Sons Inc., 2006, 800 pages (50 %).
- W. L. Mc Cabe, J. C. Smith, P. Harriott, Unit Operations of Chemical Engineering, 6th Ed., Mc Graw-Hill, 2001 1152 pages.

Cilji in kompetence:	**Objectives and Competences:**
Cilji predmeta so, da študentje povežejo do te stopnje pridobljena relevantna znanja, da osvojijo osnovne zakonitosti separacijskih procesov in da osvojena znanja uporabijo pri analizi in načrtovanju separatorjev oziroma separacijskih procesov. Predmet predstavlja zaključni del kemijsko inženirskega študija, v katerem študent poveže znanja masnih in toplotnih bilanc, faznega ravnotežja in transportnih pojavov; znanja, ki omogočajo načrtovanje oziroma analizo separacijskih naprav. Metoda dela vključuje: - inženirsko nastavitev problema - matematični zapis - reševanje matematičnega zapisa - preverjanje dobljenega rezultata. Nivoji dela zajemajo produkt, opremo in proces z upoštevanjem energetsko ekoloških vidikov, ki pripeljejo do smiselnih ekonomskih rešitev. Na podlagi matematičnega zapisa za posamezen separacijski proces pridobi matematični model, ki omogoča analizo parametrskih občutljivosti, rezultat v	The objective is to acquire relevant knowledge of fundamental characteristics of separation processes and applying this knowledge in the analysis and design of separation equipment and separation processes. Course represents important part of chemical engineering study by combining knowledge of mass and heat balances, phase equilibrium and transport phenomena – all needed for design and analysis of separation equipment. The course contains: • problem definition • mathematical formulation • solution of the mathematical problem • model verification Parameter realted to product, equipment and the entire process are analysed considering energy and ecological aspects, both leading to sustainable economic solutions. On the basis of mathematical formulation for a specific separation process, a mathematical model is developed, which allows analysis of parametric sensitivity. The result leads to estimation of time needed for mass transfer between phases

naslednji delovni fazi vodi do časa potrebnega za prenos snovi med fazama, oziroma čas separacije faz. Na osnovi eksaktno pridobljenih osnovnih informacij študent pristopi k načrtovanju separacijskega procesa oziroma k dimenzioniranju za ta proces primernega aparata. Vsaka od delovnih nalog zahteva pridobitev in razvoj specifičnih kompetenc, ki vodijo k formiranju kompetentnega in kompetitivnega kemijskega inženirja.	or phase separation. Based on the selected literature information, design of separation process and required equipment is performed. Each task requires acquirement and further elaboration of specific skills resulting in competent and competitive chemical engineer.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent je po osvojitvi znanj tega predmeta sposoben obravnavati prehod surovine do produkta skozi separacijski proces, izbrati primerno opremo in določiti procesne pogoje. Za enostavne primere je sposoben pripraviti matematični algoritem, ki omogoča analizo parametrske občutljivosti. Primerjava adiabatnih procesov pri sušenju, ravnotežni destilaciji, kristalizaciji omogoča refleksijo znotraj primerljivih problemov. Primerjava oblik tokov, čepastega toka s popolnim povratnim mešanjem, prečnega, razvija integralno sliko o dogajanjih v aparatih.	Knowledge and Comprehension After course is completed a student is able to analyse product flow throughout the separation process, to selecting appropriate equipment and to determine process parameters. For simple cases is able to develop mathematical algorithm enabling parameter sensitivity analysis. Comparison of adiabatic processes of drying, flash distillation and crystallization allows analysis of similar processes. Incorporating understanding of different flow profiles (such as e.g. plug flow with mixing) provides a comprehensive understating of phenomena occurring inside separation equipment.
Uporaba Pri analizi obstoječih separatorjev v industriji študent uveljavlja kvantitativne metode za optimizacijo, kar je značilno za procesno inženirstvo, pri načrtovanju separacijskih procesov za nove produkte pa sledi konceptu produktnega inženirstva, v katerem mora začeti osvajati znanja za prenos dosežkov iz laboratorija v pilotske in industrijske dimenzije.	Application Through analysis of existing industrial separation equipment, student introduces quantitative methods for process optimization, operation typical for process engineering during design of separation processes of novel products. Alternatively, student is following product engineering concepts which provide guidelines for transfer from laboratory to industrial scale.
Refleksija Na osnovi primerjav med reakcijskimi in separacijskimi procesi spoznava vlogo transportnih pojavov, kemijskega in faznega ravnotežja, toplotnih in masnih bilanc ter specifično vlogo reakcijske kinetike. Na podlagi pridobljenih znanj in strokovne ter znanstvene literature študent pristopa k reševanju realnih industrijskih problemov, da	Analysis Based on parallels between reaction and separation processes student realizes role and importance of transport phenomena, chemical and phase equilibrium, mass and heat balances together with specific role of chemical kinetics. Combining acquired knowledge with literature data and scientific literature enables students their implementation in solving real-life

osvojena faktografska znanja obogati z aplikativnimi in išče izzive za doseganje inovativnih znanj.	industrial challenges as well as adopting theoretical knowledge with application skills that results in innovative solutions.
Prenosljive spretnosti V povezavi s predmetom Reakcijsko inženirstvo je usposobljen kvantitativno obravnavati linijo prehoda reaktantov v produkte, tako z vidika reakcijskih kot separacijskih procesov. Na podlagi pridobljenih znanj in strokovne literature rešuje naloge in se seznanja z izdelovanjem projektov.	Skill-transference Ability Together with the knowledge from other courses of chemical engineering student is able to perform quantitative analysis of substrate transformation into the products including both, reactive and separation aspects. Student is also trained to combine literature data, knowledge and personal skills to solve specific tasks and for project preparation.

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Seminarska naloga, pisni in ustni izpit.		Seminar, written and oral exam

Reference nosilca / Lecturer's references:

Smrekar, Vida, Smrekar, Franc, Štrancar, Aleš, **Podgornik, Aleš**. Single step plasmid DNA purification using methacrylate monolith bearing combination of ion-exchange and hydrophobic groups. *J. chromatogr., A*, 2013, vol. 1276, str. 58-64, doi: 10.1016/j.chroma.2012.12.029.

Smrekar, Vida, **Podgornik, Aleš**, Lendero Krajnc, Nika, Smrekar, Franc, Krajnc, Peter, Štrancar, Aleš. Characterisation of grafted weak anion-exchange methacrylate monoliths. *J. chromatogr., A*, 2008, vol. 1207, iss. 1/2, str. 84-93. http://dx.doi.org/10.1016/j.chroma.2008.08.027, doi: 10.1016/j.chroma.2008.08.027. [COBISS.SI-ID 12459542],

Brne, Peter, **Podgornik, Aleš**, Benčina, Katja, Gabor, Boštjan, Štrancar, Aleš, Peterka, Matjaž. Fast and efficient separation of immunoglobulin M from immunoglobulin G using short monolithic columns. *J. chromatogr., A*, 2007, issue 1, vol. 1144, str. 120-125. [COBISS.SI-ID 3395192]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SODOBNE METODE KARAKTERIZACIJE MATERIALOV
Course Title:	MODERN METHODS OF MATERIALS CHARACTERIZATION

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

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: INSI32

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: Doc. dr. Boštjan Genorio / Dr. Boštjan Genorio, 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):
1. Disperzni sistemi: Definicija disperznega sistema, merjenje velikosti in porazdelitve velikosti v disperznem sistemu, določevanje faktorja oblike delcev, specifična površina disperznega sistema, določevanje poroznosti. **2. Mikrostruktura materialov**: Optična in elektronska mikroskopija (SEM, TEM), mikroskopija na atomsko silo (AFM), vrstična tunelska mikroskopija (STM) in kvantitativna analiza mikrostrukture materialov. 3. **Merjenje termičnih lastnosti materialov**: Osnove termogravimetrije (TG), diferenčne dinamične kalorimetrije (DSC), diferenčne termične analize (DTA). Osnove in načini merjenja kinetike v trdnih sistemih, merjenje	**1. Disperse systems**: Definition of disperse systems, particle size and size distribution measurements, shape factor determination, specific surface of a disperse system, porosity measurements. **2. Materials microstructure**: optical and electron microscopy (SEM, TEM), atomic force microscopy (AFM), scanning tunneling microscopy (STM), microstructure quantitative analysis of materials. 3. **Thermal properties of materials**: Principles of Thermogravimetric Analysis (TG), differential scanning calorimetry (DSC), differential thermal analysis (DTA). Basic principles of kinetics in solids and temperature measurements.

temperature. 4. **Kristalna struktura**: Osnove kristalografije, osnove metod rentgenske difrakcije (XRD), povezava lastnosti materialov in njihove kristalne strukture, osnove EXAFS metode. **5. Mehanske lastnosti materialov**: Elastična in plastična deformacija, natezni testi, duktilen in trden lom materialov, določevanje trdote materialov, testi utrujanja materialov, testi lezenja. 6. **IR in Ramanska spektroskopija**: Teorija IR in Ramanske spektroskopije, merjenje IR in Ramanskih spektrov. 7. **Električne lastnosti materialov**: Principi ciklične voltametrije, principi impedančne spektroskopije. 8. **Površina materialov**: Principi rentgenske fotoelektronske spektroskopije (XPS) in ostalih spektroskopskih tehnik v ultra-visokem vakuumu ter elipsometrija.	4.**Crystalline structure**: Basics of crystallography, theory of the X-rays diffraction methods (XRD), Comparison of structures and properties of the solids, basics of EXAFS analysis. 5. **Mechanic properties of solids**: Elastic and plastic deformation, tensile testing, ductile and brittle fracture, hardness testing, fatigue and creep testing. 6. **IR and Raman spectroscopy**: Theory of IR and Raman spectroscopies, Principles of IR and Raman measurements. 7. **Electrical properties of materials**: Principles of cyclic voltammetry and principles of impedance spectroscopy. 8. **Surface of materials**: Principles of X-ray photoelectron spectroscopy and other ultra high vacuum spectroscopic techniques and ellipsometry.

Temeljna literatura in viri / Readings:

1. D.A. Skoog, F.J. Holler, T.A. Nieman, Principles of instrumental analysis, Saunders College Publishing, Philadelphia, 1992, 849 strani (40%)
2. J.W. Dodd, K.H. Tonge, Thermal methods, John Willey & Sons, Chichester, 1987, 337 strani (20%)
3. L. Ling Ooi, Principles of X-ray crystallograhpy, Oxford University Press, Oxford, 2010, 208 strani (20%)
4. D.C. Koningsberger, R. Prins, X-ray Absorption, Principles, techniques of EXAFS, SEXAFS and XANES, John Wiley & Sons, New York, 1988, 688 strani (10%)
5. J.R. Ferraro, K. Nakamoto, C.W. Brown, Introductory Raman Spectroscopy, Academic Press, 2003, 434 strani (10%)

J. Ross MaCdonald, Ed., Impedance spectroscopy emphasising solid materials and systems, J. Wiley & Sons, Inc., New York, 1987, 368 strani (10%)

Cilji in kompetence:	**Objectives and Competences:**
Nagel razvoj tehnike temelji na novih in izboljšanih materialih in zahteva poznavanje metod njihove karakterizacije. Študent se seznani s principi in načini merjenja določenih lastnosti anorganskih materialov ter s pomenom opisane karakteristike za uporabnost materialov.	Development of technologies based on new improved materials requires also understanding of basic principles of materials characterization. Students acquire basic knowledge and ability regarding materials characterization.
Predvideni študijski rezultati:	**Intended Learning Outcomes:**

Znanje in razumevanje Študent spozna osnovne fizikalne principe na katerih temeljijo metode analize materialov. Z razumevanjem principov in rezultati analiz je študent sposoben kritično ovrednostiti različne materiale.	Knowledge and Comprehension Basic knowledge about physical principles of materials characterization on which students can describe various materials.
Uporaba Skozi principe karakterizacije materialov študentje spoznajo nekatere tehnološko najpomembnejše materiale (konstrukcujske nateriale, materiale za elektroniko, inženirsko keramiko) ter načine njihove evalvacije.	Application Through materials characterization students describe various technologically important materials (i.e. construction materials, engineer cheramics, materials for electro applications).
Refleksija Študent pridobi nujno potrebna znanja in občutek za spremljanje procesa skozi karakterizacijo materialov.	Analysis Students acquire basic knowledge to follow materials' preparation through their characterization.
Prenosljive spretnosti Razvita sposobnost kritičnega razmišljanja in sklepanja. Sposobnost povezovanja osnovnih znanj ter študija domače in tuje literature.	Skill-transference Ability Integration of basic knowledge regardin material science, literature research; literature data collecting, data analysis and interpretation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- Predavanja, - laboratorijske vaje	Lectures, seminars, tutorial work

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

Reference nosilca / Lecturer's references:

1. Genorio B, Lu W, Dimiev A M, Zhu Y, Raji A-R O, Novosel B, Alemany L B and Tour J M 2012 In Situ Intercalation Replacement and Selective Functionalization of Graphene Nanoribbon Stacks ACS Nano 6 4231–40

2. Genorio B and Znidarsic A 2014 Functionalization of graphene nanoribbons J. Phys. D. Appl. Phys. 47 094012

3. Genorio B, Staszak-Jirkovský J, Assary R S, Connell J G, Strmcnik D, Diesendruck C E, Lopes P P, Stamenkovic V R, Moore J S, Curtiss L A and Markovic N M 2016 Superoxide (Electro)Chemistry on Well-Defined Surfaces in Organic Environments J. Phys. Chem. C acs.jpcc.5b12230

4. S.-Jirkovsky J, Subbaraman R, Strmcnik D, Harrison K L, Diesendruck C E, Assary R S, Frank O, Kobr L, Wiberg G K H, Genorio B, Connell J G, Lopes P P, Stamenkovic V, Curtiss L A, Moore J S, Zavadil K R and Markovic N M 2015 Water as a promoter and catalyst for dioxygen electrochemistry in aqueous and organic media ACS Catal. 5 6600–7

5. Staszak-Jirkovský J, Malliakas C D D, Lopes P P P, Danilovic N, Kota S S S, Chang K-C, Genorio B, Strmcnik D, Stamenkovic V R R, Kanatzidis M G and Markovic N M 2015 Design of active and stable Co-Mo-Sx chalcogels as pH-universal catalysts for the hydrogen evolution reaction Nat Mater advance on 1–8

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 (radiji atomov in ionov, ionizacijske energije,	**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).

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

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

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Poglobiti in nadgraditi znanje splošne in anorganske kemije, pridobljeno na srednji šoli, ki je potrebno za nadaljnji študij. Poudarek je na poznavanju in pravilnim razumevanjem osnovnih kemijskih zakonitosti ter poznavanju zgradbe snovi in njenega vpliva na kemijske lastnosti snovi. **Kompetence:** Študent pozna in razume osnovne kemijske zakonitosti, principe in teorije ter jih zna uporabiti pri reševanju preprostih problemov (kvalitativno ali kvantitativno). Je sposoben poiskati in ovrednotiti določene podatke o snoveh in jih zna povezati z njihovimi lastnostmi.	**Objectives:** Deepening and upgrading the knowledge of general and inorganic chemistry, ackquired 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 asses the meaning of basic chemical principles and theoretical knowledge for an explanation of experimental facts and properties of compounds.

Prenosljive spretnosti	Skill-transference Ability
Študent zna poiskati podatke iz strokovne literature, podatke iz virov medmrežja pa zna kritično oceniti; zna uporabljati strokovni jezik (pisno in ustno).	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).